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LEVEL II

FINAL SURVEY STUDY for GREAT LAKES and ST. LAWRENCE SEAWAY NAVIGATION SEASON EXTENSION

VOLUME I

MAIN REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT

AUGUST 1979

U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER / 2. GOVT ACCESSION NO. AD-A084 203	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Final Survey for Great Lakes and St. Lawrence Seaway Navigation Season Extension.	5. TYPE OF REPORT & PERIOD COVERED Survey Report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U. S. Army Engineer District Detroit	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of the Army U.S. Army Engineer District, Detroit P. O. Box 1027 Detroit, Michigan 48231	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE August 1979
	13. NUMBER OF PAGES 6 vols
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Navigation
Winter navigation
Great Lakes
St. Lawrence Seaway
Environmental Plan of Action
Adoptive Method
Navigation Season Extension
Phased Improvement

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the Final Report for the Great Lakes and St. Lawrence Seaway Navigation Season Extension feasibility study. The goal of this study is to consider the feasibility of means of extending the navigation season on the entire system from mid-December to early April (year-round). The report uses, as a base condition, the Chief of Engineers 16 November 1977 report which recommends the extension of the navigation season on the upper four Great Lakes to 31 January (± 2 weeks). The purpose of this study is to determine whether

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Federal participation in Navigation Season Extension is desirable, and its extent, if any, to address the significant social, environmental, economic, engineering and institutional aspects, and, to make a recommendation for Congressional consideration based on these findings.

This Final Report evaluates six proposals, considering various season lengths and geographic coverages, to further extend the navigation season on the entire Great Lakes/St. Lawrence Seaway System up to 12 months on the upper four Great Lakes, and up to 11 months on the Welland Canal, Lake Ontario and the International Section of the St. Lawrence River. This report relates U. S. costs to U. S. Benefits.

This study concludes that season extension is engineeringly and economically feasible year-round on the upper three Great Lakes, up to year-round on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to 10 months on Lake Ontario and the International Section of the St. Lawrence River. It is recognized that formal agreement with the Government of Canada is required for any extension on the system beyond the upper three Great Lakes. To assure and to confirm environmental and social feasibility of this program, an Environmental Plan of Action (EPOS) would be accomplished concurrently with implementation and execution of post-authorization planning, engineering, construction and operations with provisions to modify or stop the program if unacceptable environmental impacts surface. The District Engineer recommends that the project, as described above, be implemented.

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SYLLABUS

Study

This is the Final Report for the Great Lakes and St. Lawrence Seaway Navigation Season Extension feasibility study. The goal of this study is to consider the feasibility of means of extending the navigation season on the entire system from mid-December to early April (year-round). The report uses, as a base condition, the Chief of Engineers 16 November 1977 report which recommends the extension of the navigation season on the upper four Great Lakes to 31 January (± 2 weeks). This report was forwarded to the Congress for information by the Secretary of the Army on 3 August 1979 (House Document No. 96-181).

Purpose

The purpose of this study is to determine whether Federal participation in Navigation Season Extension is desirable, and its extent, if any, to address the significant social, environmental, economic, engineering, and institutional aspects, and, to make a recommendation for Congressional consideration based on these findings.

Scope

This Final Report evaluates six proposals, considering various season lengths and geographic coverages, to further extend the navigation season on the entire Great Lakes/St. Lawrence Seaway System up to 12 months on the upper four Great Lakes, and up to 11 months on the Welland Canal, Lake Ontario and the International Section of the St. Lawrence River. Extension to 12 months on the St. Lawrence River is not considered possible at this time due to the potential need for lock twinning which is outside the scope of this study. Extension up to 11 months on the Welland Canal and on the St. Lawrence River is uncertain at this time because it is not presently possible to define with a high degree of certainty the Canadian position. This report relates U.S. costs to U.S. benefits.

Recommendation

This study concludes that season extension is engineeringly and economically feasible year-round on the upper three Great Lakes, up to year-round on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to 10 months on Lake Ontario and the International Section of the St. Lawrence River. It is recognized that formal agreement with the Government of Canada is required for any extension on the system beyond the upper three Great Lakes. To assure and to confirm environmental and social feasibility of this program, an Environmental Plan of Action (EPOA) would be accomplished concurrently with implementation and execution of post-authorization planning, engineering, construction and operations with provisions to modify or stop the program if unacceptable environmental impacts surface. The EPOA would involve a program of environmental baseline data collection and assessment prior to construction, environmental monitoring during construction and operations to provide

information for identifying change and adjusting policy and management actions, and a validation process to confirm continuation of the project, if justified. Accordingly, the District Engineer recommends implementation of the project described above.

Based on October 1979 price levels, an interest rate of 7-1/8 percent on a 50-year project life, the estimated total investment cost 1/ for the project is $450,969,000; with a total operation and maintenance cost of $18,867,000. The average annual cost is $52,061,000. The average annual benefits are $205,666,000. The corresponding benefit/cost ratio is 4.0.

Canadian Co-participation

Formal U.S. Government agreement with the Government of Canada is required for any extension on the system beyond the upper three Great Lakes.

Controversy

The adequacy of procedures for environmental study and monitoring prior to project implementation has been strongly questioned by a number of Great Lakes State Governors, State and Federal agencies, interest groups and individual citizens throughout the Great Lakes/St. Lawrence River region. Riparian interests have continually expressed concern that any damages to shoreline and shore structures resulting from extended season navigation be subject to compensation and/or protection measures which are lasting. The State of New York has generally opposed an extended season program on the St. Lawrence River based on the magnitude of potentially negative environmental and economic impacts as compared to benefits which the State might receive. Some private citizens and competing transportation interests consider the evaluation of the impact on alternative transportation modes inadequate.

1/ Investment Cost: The first cost plus interest during construction, i.e. $441,625,000 (First Cost) + $9,344,000 (Interest during Construction) = $450,969,000 (Total Investment Cost). See Appendix L for definitions of terms.

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FINAL SURVEY STUDY.

for

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GREAT LAKES and ST. LAWRENCE SEAWAY NAVIGATION SEASON EXTENSION.

Volume I.

MAIN REPORT and Final Environmental Impact Statement.

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AUGUST 1979
U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

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AUGUST 1979

GREAT LAKES AND

ST. LAWRENCE SEAWAY

NAVIGATION SEASON EXTENSION

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GREAT LAKES AND ST. LAWRENCE SEAWAY NAVIGATION SEASON EXTENSION

INTRODUCTION

NAVIGATION SEASON EXTENSION

The Great Lakes/St. Lawrence Seaway System consists of the five Great Lakes, their connecting channels, canals, and harbors, and the St. Lawrence River. Traditionally, because severe winter conditions made shipping difficult, the Sault Ste. Marie (Soo) Locks, the Welland Canal, and the St. Lawrence River have been closed from mid-December to early April, thus keying the winter shutdown of shipping through the system. In certain local areas, commodity movement takes place beyond winter shutdown without direct Federal action.

The year 1979 marks the eigth year of a Federal program to determine if a permanent Federally supported project to extend the navigation season on the Great Lakes and St. Lawrence River is in the best interest of the Nation. In light of the experience of this eight-year demonstration program, this final report analyzes the feasibility of means of extending the navigation season in terms of economic, engineering, environmental and social considerations and based upon its conclusions, recommends a course of action. Upon approval by higher departmental authority, the decision as to a permanent Federally supported program ultimately will be made by the Legislative branch of the Federal government.

STUDY AUTHORITY

The River and Harbor Act of 1970 (Public Law 91-611) authorized a multi-faceted program to assist in determining if a permanent Federally supported project is in the best interest of the Nation. This authorization is cited below in its entirety.

Sec. 107. (a) The Secretary of the Army, acting through the Chief of Engineers, is authorized to conduct a survey of the Great Lakes and Saint Lawrence Seaway to determine the feasibility of means of extending the navigation season in accordance with the recommendations of the Chief of Engineers in his report entitled "Great Lakes and Saint Lawrence Seaway--Navigation Season Extension."

(b) The Secretary of the Army, acting through the Chief of Engineers, in cooperation with the Departments of Transportation, Interior, and Commerce, including specifically the Coast Guard, the Saint Lawrence Seaway Development Corporation, and the Maritime Administration; the Environmental Protection Agency; other interested Federal agencies, and non-Federal public and private interests, is authorized and directed to undertake a program to demonstrate the practicability of extending the navigation season on the Great Lakes and Saint Lawrence Seaway. Such program shall include, but not be limited to, ship voyages extending beyond the normal navigation season; observation and surveillance of ice conditions and ice forces; environmental and ecological investigations; collection of technical data related to improved vessel design; ice control facilities, and aids to navigation; physical model studies; and coordination of the collection and dissemination of information to shippers on weather and ice conditions. The Secretary of the Army, acting through the Chief of Engineers, shall submit a report describing the results of the program to the Congress not later than July 30, 1974. There is authorized to be appropriated to the Secretary of the Army not to exceed $6,500,000 to carry out this subsection.

(c) The Secretary of Commerce, acting through the Maritime Administration, in consultation

with other interested Federal agencies, representatives of the merchant marine, insurance companies, industry, and other interested organizations, shall conduct a study of ways and means to provide reasonable insurance rates for shippers and vessels engaged in waterborne commerce on the Great Lakes and the Saint Lawrence Seaway beyond the present navigation season, and shall submit a report, together with any legislative recommendations, to Congress by June 30, 1971.

Section 107 (b) of Public Law 91-611 was amended by the Water Resources Development Act of 1974 (Public Law 93-251) as follows:

> Sec. 70. Section 107(b) of the River and Harbor Act of 1970 (84 Stat. 1818, 1820) is hereby amended by deleting "July 30, 1974" and inserting in lieu thereof "December 31, 1976", and deleting "$6,500,000" and inserting in lieu thereof "$9,500,000".

The Water Resources Development Act of 1976 (Public Law 94-587) further amended Section 107(b) of Public Law 91-611 as follows:

> Sec. 107. Section 107(b) of the River and Harbor Act of 1970 (84 Stat. 1818, 1820), as amended, is further amended by striking out "December 31, 1976" and inserting in lieu thereof "September 30, 1979" and striking out "$9,500,000" and inserting in lieu thereof "$15,968,000". Such section 107(b) is further amended in the second sentence thereof by striking out "environmental and ecological investigation;" and inserting in lieu thereof "environmental and ecological investigations, including an investigation of measures necessary to ameliorate any adverse impacts upon local communities:".

SCOPE OF THE STUDY

Purpose of the Report

This report, prepared under Section 107(a) of the River and Harbor Act of 1970, has the following purposes:

1. to present plans for extending the season;

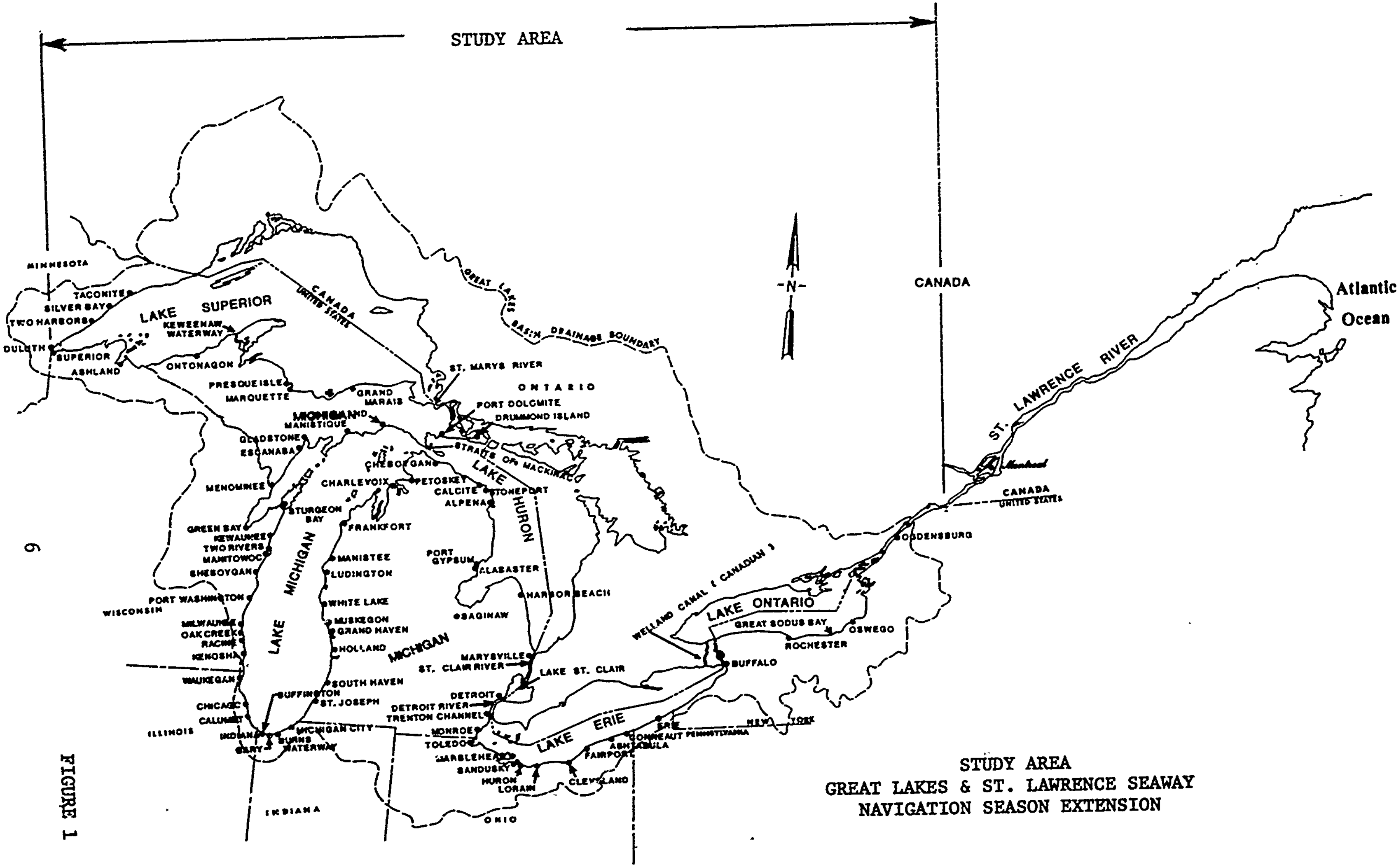
2. to summarize the problems and needs and alternative solutions associated with any season extension; and,

3. to present information, conclusions and a recommendation as to the feasibility of a Federally supported permanent navigation season extension program.

Authorizing Limits

The Great Lakes and St. Lawrence Seaway Navigation Season Extension Study, as authorized by Congress in its three distinct sections, explicitly limits the scope of investigation. Study efforts included investigating the feasibility of means of extending the navigation season on the entire system into the winter months, beyond the usual eight and one-half month season to as much as year-round, and to determine the desirability and extent of Federal participation. The authorizing language leaves no latitude for investigation of other system improvements to increase the capacity or the productivity of the Great Lakes and St. Lawrence Seaway Navigation System. The eight-year Demonstration Program, which forms the primary data base for means and methods of controlling and managing ice and for determining the practicability of vessel operation in ice, has been carried out under this directed scope. This feasibility report is similarly directed. It should be noted at the outset that relevant system matters such as lock capacity, channel dimensions, impacts on levels and flows, and other navigational matters and features were explored relative

to their application to winter navigation. However, none of these is a purpose of the investigation as defined in the scope. Further, the scope of this study involves U.S. facilities, harbors, shorelines, the five Great Lakes and connecting channels and canals, and the International Section of the St. Lawrence River. The study area under consideration in this report is shown on Figure 1. Because of the scale and complexity of this study, the evaluation given in this report does not reflect specific impacts in terms of location or magnitude, but provides insight to types to be expected.



STUDY AREA
GREAT LAKES & ST. LAWRENCE SEAWAY
NAVIGATION SEASON EXTENSION

FIGURE 1

Limitations Relating to Canada

The scope of the study is directed solely towards a U.S. plan of season extension improvements and to U.S. benefits accruing from extended season traffic. This limitation of the authorization recognizes the international character of the Great Lakes/St. Lawrence Seaway System and the need for Canadian coordination and co-participation in implementing a system-wide navigation season extension project. The study considers all known Canadian plans for winter navigation projects that would affect U.S. proposals. It is not within the scope of this study to include a Canadian plan of improvement, or to determine Canadian benefits and costs. Environmental impacts to the International Section of the St. Lawrence River and the Canadian waters and shores are considered in the evaluation of alternative plans when pertinent.

STUDY PARTICIPATION AND COORDINATION

Extensive coordination and participation of Federal, State, and local agencies, interest groups, and concerned citizens has occurred since the study was authorized in 1970.

A significant contribution to this study is provided through the effort of various Federal, non-Federal, public, and private interests represented on the Winter Navigation Board. This Board was formed in November 1971 by a Memorandum of Understanding to plan, program, budget, and approve, for execution, the work of these interests on activities under the Demonstration Program portion of the navigation season extension program.

The purpose of the Program is to demonstrate various means of extending the season throughout the system to determine practicability and cost-effectiveness of these means. This information in turn is used in the feasibility report.

Federal agencies participating in the Demonstration Program include: the Department of Transportation (St. Lawrence Seaway Development Corporation and U.S. Coast Guard); Department of the Interior (U.S. Fish and Wildlife Service); Department of Commerce (National Oceanic and Atmospheric Administration, and Maritime Administration); Department of Defense (U.S. Army Corps of Engineers); Environmental Protection Agency; and Department of Energy (Federal Energy Regulatory Commission).

The Great Lakes Basin Commission, the Great Lakes Commission, the eight Great Lakes States, and business and labor interests are also represented on the Board.

The National Aeronautics and Space Administration (NASA) and the Energy Research and Development Administration act as technical advisors to the Winter Navigation Board.

Two agencies of Transport Canada (St. Lawrence Seaway Authority and the Canadian Coast Guard), the International Joint Commission, and the U.S. Department of State are represented on the Board as observers.

As part of the Board, a Working Committee, similarly constituted, had the responsibility of executing the Board-approved activities and provides continuous coordination of program activities. The committee consisted of the representatives of seven work groups, along with representatives of regional, advisory, and observer groups. The seven work groups under the Working Committee conduct and coordinate activities under each of seven functional elements: Ice Information; Ice Navigation; Ice Engineering; Ice Control; Ice Management; Economic Evaluation; and Environmental Evaluation.

In addition to the coordination within the Board structure, considerable coordination with the public occurred as the Board and Working Committee implemented demonstration activities. As an example, the public played a very significant role in the development of operational plans

along the St. Marys River to permit near-normal operation in the river, and between islands in the river and the mainland, while allowing commercial navigation to continue as long as possible into the winter season during the years of the Demonstration Program.

A very essential and necessary part of study participation and coordination was through an active public involvement program. Public involvement in the survey study started with formal public meetings in 1972 held in Chicago, Illinois; Cleveland, Ohio; and Duluth, Minnesota. A mailing list was developed during the course of this study. The list consists of approximately 4,200 names of Congressional, Federal, State, county, and city officials; navigation, business, and industrial interests; environmental and conservation groups; media; engineering and planning consultants; and other interested individuals from throughout the Great Lakes Region. It is used to keep the public informed as to public participation sessions in the form of workshops and meetings, and to encourage their active participation in the study planning process.

Since 1972, two additional series of public meetings were held in January 1974 (Duluth, Minnesota; Sault Ste. Marie, Michigan; and Detroit, Michigan) and in February 1976 (Duluth, Minnesota; Sault Ste. Marie, Michigan; Detroit, Michigan; and Cleveland, Ohio) to present to the public the findings and recommendations of an interim report on extending the navigation season in the upper four Great Lakes to 31 January and to solicit their views.

A public seminar was held in December 1972 in Detroit, Michigan, to provide a forum for expression of views and discussion by all parties who have an interest in the Winter Navigation Program.

A public workshop was held in July 1975 at Sault Ste. Marie, Michigan, to obtain citizens' views, ideas, and concerns regarding: 1) possible impacts along the St. Marys River shoreline due to vessel transit during

the winter; and 2) the results of a study conducted in 1974 on the effects of winter navigation on the St. Marys River shoreline.

A public meeting was held in January 1977 at Sault Ste. Marie, Michigan, to ascertain public needs and views relative to the Navigation Season Extension Survey Study and Demonstration Program. Additionally, the concept of future direction of both the Survey Study and Demonstration Program was presented to the public in Cleveland, Ohio, on 6 October 1977.

An additional series of nine workshops was conducted in 1977, sponsored by the U.S. Fish and Wildlife Service as agents for the U.S. Army Corps of Engineers. These workshops were held at five locations along the Great Lakes (Duluth, Minnesota; Sault Ste. Marie and Dearborn, Michigan; Chicago, Illinois; and Watertown, New York). The purpose of these workshops was to obtain citizen input relative to potential environmental, economic, and social impacts of winter navigation.

In August and September 1978, a series of eight public workshops was held at various locations along the Great Lakes (Duluth, Minnesota; Sault Ste. Marie and Port Huron, Michigan; Milwaukee, Wisconsin; Chicago, Illinois; Toledo and Cleveland, Ohio; and Ogdensburg, New York). Digests of these meetings are included in Appendix C. The purpose of these workshops was to obtain the public's views, questions, and concerns on proposals regarding plans to extend navigation to as much as year-round, and to allow members of the public to express their opinions as to how and if they believed the program would affect their lifestyle or provide them and their communities with future economic benefits/disbenefits.

The last series of public meetings was conducted in April and May 1979. These meetings were held at seven locations throughout the Great Lakes area (Gary, Indiana; Detroit and Sault Ste. Marie, Michigan; Duluth, Minnesota; Cleveland, Ohio; Massena and Watertown, New York). The purpose of these meetings was to inform the public of the study progress and to present to

the public the findings and tentative recommendations on the problems and alternative solutions as presented in the March 1979 Draft Survey Report and Draft Environmental Impact Statement.

The Fish and Wildlife Coordination Act of 1958 (P.L. 624-85) provides that fish and wildlife conservation shall receive equal consideration with other project purposes and be coordinated with other features of water resources development programs. Adverse effects on fish and wildlife resources, and opportunities for improvement of fish and wildlife have been initially examined in the Survey Study. The Fish and Wildlife Coordination Act Report appears in Appendix G.

Further detailed examination would continue in the post-authorization stage along the lines indicated in the Environmental Plan of Action. To this end, all pre-authorization and post-authorization planning or project development, without exception, shall continue to be coordinated with the U.S. Fish and Wildlife Service of the Department of the Interior, the National Marine Fisheries Service of the Department of Commerce, as appropriate, and the agency administering the fish and wildlife resources of the state wherein impacts may possibly occur.

A review of all previously identified social effects and a projection of a range of potential future effects were made and are presented in Appendix H. Social effects were identified in four major categories: recreation, shore erosion and structure damage, cross channel transportation, and occupational groups.

In addition, the most recent views of key Federal and State agencies on the tentative findings are presented in the section entitled "Views of Federal Interests" and "Views of State Interests" in the latter part of this Main Report. Also, correspondence received from concerned local interests, both public and private, is presented in Appendix C. A detailed public participation and coordination program is outlined in Appendix C.

The scope of the study for a navigation season extension is limited, by Congressional authorization, to United States harbors, facilities and waters, and to the International Section of the St. Lawrence River. It is thus directed to a United States plan of season extension improvements, and to the U.S. benefits accruing from extended season traffic. The international character of the Great Lakes/St. Lawrence Seaway System and the need for Canadian coordination and co-participation in implementing a system-wide navigation season extension project have been recognized.

Canadian interest in the Navigation Season Extension Program has been demonstrated in several ways. Canada has been represented on the Winter Navigation Board since its inception by providing an observer to the Board. The Canadian and United States Coast Guard have prepared and distributed Joint Icebreaking Agreements for the past several years, resulting in Canadian icebreaking support for participating vessels. Canadian vessels have been sailing during past extended seasons under the Demonstration Program in significant numbers. Thirteen Canadian companies sailed 62 vessels during the 1977-78 extended season. The St. Lawrence Seaway Authority of Canada has undertaken a number of improvements in Canadian reaches of the St. Lawrence River which have enhanced shipping operations during mid-December and early spring periods. It is recognized that, while such informal coordination is useful to both countries, and essential to the United States investigation, it will not provide the formal position of Canada necessary in the report to Congress at the completion of the study. Therefore, in 1977, the Winter Navigation Board also submitted a request to the U.S. Department of State for formal discussions between the United States and Canada, designed to secure agreement on a program of bilateral cooperation in navigation season extension activities and related environmental and other studies.

The Department of State on 14 November 1978 sent an Aide Memoire to the Canadian Government proposing a meeting on the Navigation Season Extension

Program. The Embassy of Canada responded on 15 March 1979 by an Aide Memoire, indicating a willingness to meet if the United States Government would submit a specific proposal arising from the Survey Study. Formal Canadian co-participation might be expected in the advanced engineering and design phase of the program once Congress had authorized a specific extended navigation season project.

Coordination with the Canadian government over environmental issues will be executed in accordance with Executive Order 12114, "Environmental Effects Abroad of Major Federal Actions" (4 January 1979), and Department of Defense, 32 CFR Part 197, "Environmental Effects Abroad of Major Department of Defense Actions, Policies and Procedures" (12 April 1979). Existing guidance requires full disclosure to Canada of the environmental impacts on its holding and any International commons shared with the Unit States. All coordination with the Canadian government will be initiated after an official Federal position has been authorized by Congress and wi be accomplished under the auspices of the U.S. Department of the State.

THE REPORT AND STUDY PROCESS

The Main Report is purposely prepared to enable a condensed review of the study scope, problems, environmental-economic-social considerations in the study, alternative solutions considered, the recommended project plan and associated implementation responsibilities of agencies, and study conclusions and recommendations.

This report is in response to the Congressional authorization which requested the Corps to determine if a permanent Federally supported program is in the best interest of the Nation. The report and its recommendation are subject to reviews by the Board of Engineers for Rivers and Harbors, the Office of the Chief of Engineers, Governors of the affected States, Secretaries of the prescribed Federal agencies, Secretary of the Army, Office of Management and Budget, and finally, Congress. Upon endorsement

by higher departmental authority, the decision as to a permanent Federally supported program ultimately will be made by the Legislative branch of the United States Government.

The final environmental impact statement in the second half of this document summarizes the known environmental impacts of the recommended project. Numerous references are made to the appropriate technical appendixes (A-L) to direct the reader to more detailed discussions of the respective topics. The appendixes are contained in the following volumes:

VOLUME I OF VI

Main Report and Environmental Impact Statement

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Appendix A - Problem Identification

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PRIOR AND ONGOING STUDIES AND REPORTS

Key prior and ongoing studies and reports conducted under Congressional authorization which are directly related to the extended season navigation study are summarized in Attachment 2 to Appendix B. These reports and studies included the following: the Great Lakes Basin Framework Study; the Great Lakes and St. Lawrence Seaway Study of Insurance Rates; Great Lakes Water Level Study; Lake Erie - Lake Ontario Waterway Study; Great Lakes Region Inventory Report National Shoreline Study; Great Lakes Connecting Channels and Harbors Study; the St. Lawrence Seaway Additional Locks Study; International Lake Erie Regulation Study; International Great Lakes Diversions and Consumptive Uses Study; and Lake Ontario Shoreline Protection Study.

PROBLEM IDENTIFICATION

ORGANIZATION APPROACH

The intent of the chapter is to (1) describe the area's water and related resource management problems, needs and opportunities that have surfaced during the eight-year study to determine the feasibility of a permanent program to extend the navigation season on the Great Lakes and St. Lawrence Seaway and (2) consider the problems as planning objectives and contraints. The types of problems, needs and opportunities considered in the study were limited to water and related resource management issues, related social setting, population growth, economic development, significant environmental phenomena and similar concerns were considered when relevant to pertinent resource management problems. Concerns were elicted through public involvement programs, public officials, interest groups, State agencies, and analyses by Corps planners.

NATIONAL OBJECTIVES

The national objectives for planning water resources projects are set forth in the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resource." The two national objectives are to enhance national economic development (NED) by increasing the value of the nation's output of goods and services and improving national economic efficiency, and to enhance the quality of the environment (EQ) by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. Later the alternative plans are evaluated as to their achievement of these two objectives, vis a vis their relative contributions to the respective accounts.

EXISTING CONDITIONS

History

The Great Lakes and their connecting channels, canals and the St. Lawrence River has served as a vital transportation corridor to the hinter lands of the United States and Canada since its discovery in the 16th and 17th centuries. This system has served both nations since the 1800's in providing an essential commercial transportation link for bringing bulk goods from its sources to the industrial and distribution centers of the Great Lakes Region for use by the two nations and the world. This was accomplished by modifying the natural waterway system during the 19th and 20th centuries by the use of channels and locks. The system is sometimes described as having an upper and lower portion. The upper portion of the system is maintained and operated by the United States and consists of Lakes Superior, Michigan, Huron and Erie, and the connecting channels and locks on the St. Marys River. The upper portion of the system can accommodate bulk carriers with drafts of 25' 6" at low water datum, lengths of 1100 feet and widths of 105 feet. There are presently eight 1000 foot bulk carriers operating and four more under construction. The lower portion of the system consists of the Welland Canal, which is operated by the Canadians, and also includes Lake Ontario and the St. Lawrence River, of which a portion called the International Section in which operation and maintenance is shared by the United States. The balance of the river is operated and maintained by Canada. The lower portion of the system can accommodate vessels with drafts of 26 feet, lengths of 730 feet and widths of 76 feet.

Historically, vessel movement throughout the system starts on or about 1 April of each year and continues through about 15 December, with some variation between the northern and southern portions of the Great Lakes. Vessel movement does take place, in varying degrees, during the period normally considered the winter closedown period. Significant commercial bulk carrier transits during the winter occurred most often during World War II, the Korean Conflict, and the several years immediately prior to the Navigation Season Extension Program. Additionally, intra-lake commerce

(within one lake) has been going on for a long time on most of the lakes. Examples of intra-lake commerce are car ferry operations on most lakes and connecting channels, the movement of coal, on Lake Erie and the Detroit River from Toledo to Detroit, and the movement of various pertroleum products on Lake Michigan and in the Detroit River, weather permitting.

Great Lakes/St. Lawrence Seaway System

The Great Lakes/St. Lawrence Seaway System consists of the five Great Lakes, their connecting channels, canals and harbors, and the St. Lawrence River to Montreal. Traditionally, because severe winter conditions made shipping difficult, the Sault Ste. Marie (Soo) Locks, the Welland Canal, and the St. Lawrence River facilities have been closed to navigation from mid- to late December until early April.

Ice conditions in the Great Lakes vary from year to year and even month to month, ranging from fast, thick winter ice, to areas of consolidated young ice, to vast areas of drifting pack ice and brash ice. Because of their large heat storage capacities, Lakes Superior and Ontario rarely freeze over completely and frequently contain large areas of open water. However, most of the connecting rivers become ice covered; only in the upper reaches of the St. Clair, Detroit, Niagara, and St. Lawrence Rivers and in localized areas of swift currents are stable ice covers prevented from forming. The Soo Locks, between Lakes Superior and Huron, the Welland Canal Locks, between Lakes Erie and Ontario, and the St. Lawrence River Locks, between Lake Ontario and Montreal Harbor, all normally close in mid- to late December and agencies utilize the winter months for maintenance and repair of facilities. Downstream from Montreal Harbor, vessels do operate on the St. Lawrence River year-round.

In certain local areas, even preceding the Demonstration Program, coal and petroleum products movement took place during the winter months and car ferries continued to operate. Along the St. Clair and Detroit Rivers, and

in western Lake Erie from Toledo, fuel shipments to Detroit River power plants continued year round. Ferries have operated across Lake Michigan, the Straits of Mackinac, the St. Marys River, and the Detroit River and St. Clair River. There have also been instances at the Soo Locks of transit being continued beyond the normal closing date under extraordinary circumstances. In the period 1965-1970, for example, the U.S. Army, North Central Division Engineer responded to the Lake Carriers' Association requests for season extensions in order that needed iron ore shipments could be continued later into the winter.

Ordinarily, though, most lake ships are tied up for the winter in home ports on Lake Superior and especially along the south shore of Lake Erie. The U.S. Coast Guard, Canadian Coast Guard, and St. Lawrence Seaway Development Corporation removed their buoys and other navigational aids prior to freeze-up to prevent loss of or damage to the buoys due to ice during the winter season and for their annual maintenance. Incidents of search and rescue missions declined significantly.

Ice conditions in the Lakes/Seaway System pose difficulties beyond the interruption of shipping. Winds and thaw conditions occasionally disrupt stable ice cover on the St. Marys River, for instance, causing loose ice to flow downstream and jam in constricted areas. By restricting the downstream flow of the river, a jam could cause upstream levels to rise, resulting in a flood threat to adjacent low lying areas. This occurs under natural conditions in the St. Marys and St. Clair Rivers.

The jammed ice also threatens power production at hydro-electric plants in the St. Marys, Niagara, and St. Lawrence Rivers by either blocking the intake gates or by temporarily restricting the flow available for power production. Ice booms are installed by various power entities in the St. Marys, Niagara, and St. Lawrence Rivers to help establish a stable ice cover, reduce the potential for ice jams, and insure a steady flow through its plants. In the St. Lawrence River, two booms extend across the navigation channel. These booms are closed when the water temperatures and

impending freeze-up dictate. This normally occurs after the passage of the last sceduled vessel. The booms are removed just prior to the beginning of spring navigation in late March.

Ice floes and ice jams also hamper ferry operations, particularly in the St. Marys River where Sugar Island and Drummond Island ferries cannot cross or dock in heavy ice conditions. Under stable conditions, the ferries usually establish and maintain a clear track in which to operate. Similarly, cross-river ferries and the local fuel deliveries in the St. Clair and Detroit Rivers are occasionally slowed or stopped by heavy ice floes or ice jams.

Moving ice, particularly in thaw or spring breakup periods, can cause damage to docks and other shore structures. Docks and shorelines in the St. Marys, St. Clair, and St. Lawrence Rivers are particularly vulnerable to damage by ice floes and/or jams. In addition, moving ice can cause occasional erosion when wind-driven ice piles up along the shoreline, gouging the bottom and removing protective cover. All of these phenomena occur naturally in the absence of any navigation.

Existing Plans and Improvements on Navigation System, Facilities and Equipment

Improvement of the connecting channels above Lake Erie to provide a controlling depth of 27 feet below low water datum (LWD) in both downbound and upbound channels was authorized on 21 March 1956. Controlling depths of 27 feet have been available since 1959 in the Welland Canal between Lake Erie and Lake Ontario and in the St. Lawrence River from Lake Ontario to Montreal, Quebec. There is a 35-foot deep shipping channel in the St. Lawrence River from Montreal to Quebec City and 41 feet deep at lowest normal tide (LNT) to the Atlantic Ocean. The Great Lakes channels are designed to provide a safe draft of 25.5 feet for Great Lakes freighters at low water datum. To provide this safe draft, the project depths from 27 to 30 feet have been available through the connecting channels since June 1962.

The existing Federal project at the St. Marys Falls Canal provides for the operation of four U.S. locks at Sault Ste. Marie, Michigan. There is also one lock on the Canadian side of the St. Marys River at Sault Ste. Marie, Ontario. The Canadian Welland Canal has a series of seven lift locks and one guard lock. The St. Lawrence River has a series of seven locks, two of which are owned and operated by the United States and five by Canada.

The limiting dimensions for ships in the MacArthur Lock at the St. Marys Falls Canal, for the Welland Canal locks and for the St. Lawrence River locks, are 730 feet in length and 76 feet in beam. The limiting dimensions of ships transiting the Poe Lock at the St. Marys Falls Canal are 1,100 feet long and 105 feet in beam. The MacArthur and Poe Locks in the St. Marys River and the locks in the Welland Canal and St. Lawrence River have depths in excess of channel depths leading to the locks. The depth of sills in the MacArthur Lock is 31 feet; in the Poe Lock, 32 feet; and in the locks in the Welland Canal and St. Lawrence River, 30 feet. Consequently, the draft of ships is limited by channel depths, and not by the locks.

Harbors

To take full advantage of the 27-foot Great Lakes Connecting Channels Project, 31 United States harbors were improved by dredging. Improvements and construction are essentially complete and provide for a 27-foot Great Lakes System at low water datum for commercial harbors. (Recreational harbors may not reflect the 27-foot depth.) The same allowances between depth and draft used in the connecting channels were used in improving the harbors. Additional depth is provided in entrances and outer harbors where required, to allow for wave action in exposed areas, the squat of ships underway, and the presence of hard bottom. Depths providing for a safe vessel draft of 25.5 feet at low water datum vary from 27 feet to 30 feet. The Corps of Engineers currently has a study underway to investigate the

feasibility of further improvements in the Great Lakes connecting channels and harbors for safe operation of vessels projected to be in the future Great Lakes fleet. This study also includes an investigation to determine the advisability of providing additional lockage facilities and increased capacity at the locks at Sault Ste. Marie, Michigan. Studies are also on-going for selected harbors within the system and for additional United States locks. Another study is underway on the feasibility of additional locks in the St. Lawrence River.

Environmental Base Condition

The Great Lakes/St. Lawrence Seaway System, including the five Great Lakes, their connecting waterways and canals, and the St. Lawrence River, forms a water highway 2,342 miles long, from Duluth, Minnesota, at the head of Lake Superior to the Strait of Belle Isle at the mouth of the Gulf of St. Lawrence. Of this, 1,270 miles are within the Great Lakes. The remainder includes the St. Lawrence River and the stretch of the Gulf of St. Lawrence to the Atlantic Ocean.

The following is an abstract of information presented in Appendix F, Environmental, and Section IV of the Final Environmental Impact Statement.

Climate. The climate of the Great Lakes Basin has four seasons with relatively temperate summer and winter temperatures. Average annual temperatures range from 39.0°F on Lake Superior to 48.7°F on Lake Erie. Minimum monthly temperatures generally occur in January or February, while maximum monthly temperatures occur during July.

Precipitation. Precipitation in the form of rain, snow, and condensation is the source of water for the Great Lakes. The mean annual precipitation (1900 - 1978) for Lake Superior, Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario basins are 29.7, 31.4, 31.4, 34.0, and 34.6 inches, respectively. The number of days having measurable precipitation

ranges from an average of 169 days east of Lake Ontario and 155 days along the southern shore of Lake Superior, to 119 days at the southern end of Lake Michigan.

Water Levels. The levels of the Great Lakes are a result of an integration of all of the hydrologic factors which affect the Great Lakes Basin. These factors include precipitation over land and the lake surfaces and rate of runoff, as well as the hydraulic characteristics of the connecting channels and the St. Lawrence River. The levels of the lakes frequently affect man's use of the waters since they control the shoreline use and navigation, and influence the amount of hydroelectric power which can be produced in the outflow rivers.

Ice jams in the connecting channels and St. Lawrence River during the winter have historically presented problems with short-term variations in water levels.

Water and Air Quality. There are many Federal, State, and local programs for the purpose of maintaining or enhancing water quality in the Great Lakes Basin. The Federal programs are primarily the responsibility of the United States Environmental Protection Agency established by Reorganization Plan No. 3, effective 2 December 1970 (42 United States Code, Annoted, Section 4321).

The adoption of water quality standards by all Great Lakes States facilitates the coordinated efforts to maintain and enhance water quality. From time to time it may be necessary to modify such standards to reflect changing conditions, changing information, and changing public wishes as to what constitutes best use of water related resources.

As the growth of population and industry creates additional pressures on water supply and quality for established uses, further emphasis is being placed on identifying areas that would require advanced waste treatment. In addition to waste treatment problems faced by municipalities and

industries, other problems may require continued attention and greater resources for their solution. Examples of such problems are soil erosion and sedimentation, combined sewer overflows, thermal discharges, wastes from water craft, oil pollution, organic and toxic contaminants, dredging activities and non-point source pollution. Plans for the control of non-point sources of pollution are currently being developed under Section 208 of the Clean Water Act (P.L. 92-500, as amended).

Topography and Geology. The river basins occupied by the Great Lakes and the St. Lawrence River were created by the Wisconsin glaciation during the Pleistocene Epoch. The present Great Lakes configuration with its outlets and existing lake levels, date back less than 3,000 years, with the subsequent processes of stream and shoreline erosion making only slight changes in the original topography. However, during previous stages in the development of the Great Lakes Basin, there have been water connections between the lakes and the following drainages: Hudson Bay and Upper Mississippi River; the Ohio and Middle Mississippi Rivers; and the Mohawk, Hudson, and Susquehanna Rivers.

Soils. The Great Lakes Basin has large areas of relatively flat land with high water tables and fine-textured soils. The land areas of much of the Great Lakes Basin were formed as glaciers receded to the north. During this final northward recession of the ice sheet, there was ponding of melt waters between the ice and the exposed glacial deposits. These glacial lakes occurred at several different elevations. At each lake level sediments were deposited. Patterns and levels of those lakes were repeatedly changed as new lower outlets were uncovered. This left extensive, relatively flat areas with fine-textured lake bed deposits.

Fisheries Resources. The Great Lakes Basin contains more than 237 kinds of fish (species and sub-species), which represent most of the important families of fresh water fishes in North America. Most of these

species are indigenous to the Basin, having entered the lakes during the last glaciation (the Wisconsin) period. In addition, exotic species are present, having been either purposely or inadvertently introduced by man. These introductions, along with past fishery management practices, have led to significant changes in the fisheries resources of the Basin.

Commercial fishing within the Great Lakes has been an important resource for over a century; however, it has been declining over the years. Prior to 1950, eleven species of fish contributed significantly to the U.S. commercial fishery: lake sturgeon, lake trout, lake herring, pike, chubs, lake whitefish, carp, suckers, catfish, yellow perch, and walleye. Of these, only the last seven have played a substantial role in the commercial fishery of the last two decades. Reduction of stock due to increased mortality from sea lamprey predation, and increased competitive pressures caused by the introduction of smelt and alewives, accelerated in some cases by overfishing, have resulted in the elimination of the first four from the commercial fishery, although they still remain as considerations in a future restored fishery. Four other species, northern pike, bullhead, sheeps-head, and quillback, have contributed to the commercial fishery to the present, but their total combined catch has represented only 1.56 percent of the total over the last 20 years. Four newly introduced species, the coho, chinook, and kokanee salmon, and the splake, may play an important part in the future fishery. Some of the more important fishing areas are the Thousand Island area of the St. Lawrence River, Saginaw Bay in Lake Huron, Lake St. Clair between the St. Clair and Detroit Rivers, and Whitefish Bay in Lake Superior.

Many of the Great Lakes States are turning to the lakes to expand the recreational fishing opportunities. The development of selective sea lamprey control chemicals in the late 1950's laid the ground work for rehabilitation of the traditional fisheries. Successful control of the lamprey opened the door for introduction of new species to fully utilize the tremendous potential of the Great Lakes to produce fish valuable as both food and a source of high quality recreation.

Sportfishing within the Great Lakes Basin has been estimated in 1970 as 81.2 million angler-days effort. Of this amount, over 16 million angler-days of effort were spent on the Great Lakes. By 1980, sport fishing activity is expected to increase to an estimated 106 million angler-days, with 27 million angler-days expected on the Great Lakes. Major species sought are lake trout, yellow perch, coho salmon, rainbow trout, brown trout, chinook salmon, walleye, northern pike, smelt, herring, channel catfish, muskellunge, small and largemouth bass, white bass, Atlantic salmon, suckers, and carp.

Wildlife Resources. There are approximately 220 species of birds and 78 kinds of mammals in the Great Lakes Basin. Upland game birds found in the Basin include ring-necked pheasants, ruffed grouse, quail, and turkey. Waterfowl include several species of geese and many species of ducks. Typical shore and marsh birds include bitterns, rails, herons, loons, red-winged blackbirds, gulls, and terns. Common non-game birds include hawks, owls, and many species of songbirds. Endangered bird species in the Basin include the peregrine falcon, bald eagle, and Kirtland warbler.

The waters of the Great Lakes and adjacent basin areas provide a flyway route for millions of North American waterfowl and breeding territories for lesser numbers of the twenty-seven species using the Great Lakes Basin. While waterfowl are distributed generally throughout the Basin, there are major concentration areas serving the migrant and breeding ducks, geese, coots, and swans. These concentration areas include Tahquamenon Bay, Lake Superior; Green Bay, and Bay de Noc, Lake Michigan; Saginaw Bay, Lake Huron; Lake St. Clair; St. Marys River; Point Pelee Marsh, Rondeau Bay, Long Point Bay, and the western end of Lake Erie; Niagara River; and the Thousand Island area in the St. Lawrence River. In addition, many marshes and shallow bays provide secondary concentration areas.

Important game animals, for which over 24 million man-days hunting were spent within the Basin, include the white-tailed deer, black bear, cottontail and snowshoe rabbit, squirrel, ring-necked pheasant, ruffed grouse, quail, geese, and migratory waterfowl. Important fur animals in the Basin are muskrat, beaver, mink, martin, and fisher.

Biological Zones. Shorelands comprise some of the most unique ecosystems in the Great Lakes Basin. The shoal water and the shoreline, with its characteristic flora, support a diversified and extremely significant fauna. Successful components of an individual shore-type environment are the dune grasses of the lake sands; the cedar, juniper, and hardwood of the Lake Huron shore; the cattails and rushes of Green Bay, Saginaw Bay, and Lake Erie; and the stunted pines, hardwoods, and rock outcrops of Lake Superior. There are approximately 400,000 acres of the primary and secondary shallow waters important for many forms of aquatic and animal life. Some 245,000 acres of bottom lands consisting of hard-packed sand, gravel, and ledge rock, are subject to wave wash and scour, provide a minimum wildlife value.

Human Environment and Resources. The physical environment of the Great Lakes Basin has exerted a strong influence over the level and distribution of population, and type and distribution of economic activities. The single most significant resource is the five Great Lakes and the connecting channels. This source of water, in addition to abundant natural resources and large agricultural potential, has allowed a highly industrial and agricultural area to develop. The United States portion of the Basin contains one-seventh of the population on four percent of the total U.S. surface area and produces one-sixth of the national income. Within the Canadian portion of the Basin, the importance is even greater. The Province of Ontario portion alone contains almost one-third of the total population of Canada and produces nearly one-third of the national income. With the Province of Ontario portion of the St. Lawrence River Basin

included, the proportion of total population and economic activity rises to over 60 percent of the Canadian national total.

Population. The Great Lakes Basin has contained 14 to 15 percent of the United States population over the period 1950 to 1975. The average population density is 113 persons per square mile, but it varies considerably from less than 20 persons per square mile in the Superior and Northern Huron basins to around 500 persons per square mile in the southern Michigan, Erie, and Ontario basins.

Employment. Employment trends for the eight states bordering the five Great Lakes have paralleled national employment shifts for most major employment sectors during the period 1940-1970. In 1970, nearly four million persons were employed in manufacturing, representing about 35 percent of the total persons employed. The major manufacturing industry group employers include primary metals, food, and kindred products. Agriculture accounted for about 1.8 percent of the Basins's employment in 1970, and mining accounted for another 0.3 percent.

Income. Historically, total personal income and per capita income within the eight states bordering the Great Lakes can be attributed to a heavy concentration of industrial activity. Basin income per capita has averaged from 10 to 20 percent above the national average during the period 1950 to 1970. Economic centers which lead the Basin in per capita income are the metropolitan areas of Chicago, Detroit, Cleveland, and Rochester.

Production. The Great Lakes Basin economy is basically industrial, utilizing the transportation and power advantages offered by the Great Lakes/St. Lawrence River system. In addition, there is significant agricultural, mining, and forestry production. Fishing, historically one of the oldest activities, has declined in commercial importance because of numerous factors.

Transportation. The region occupies a location strategic to the highly industrialized and well-populated north central United States and south central Canada, and is astride the transcontinental link between the major agricultural production regions of the West and Midwest and the consuming areas of the East. The Great Lakes/St. Lawrence Seaway system provides 27-foot deep navigation channels from Duluth-Superior to Montreal, 35-foot channels from Montreal to Quebec City, and 41 foot channels at the lowest normal tide from Quebec City to the Altantic Ocean. Over 100 billion ton-miles of waterborne freight are transported on this system each year. In addition to water transportation, major airports are located throughout the Great Lakes Region such as at Buffalo, Cleveland, Detroit, Chicago, and Duluth. Also, a very elaborate network of highways and rail systems serve the Great Lakes Region and tie major ports to the hinterland of the region and other parts of the country.

Recreation. The Great Lakes Basin has 17.8 million acres of public recreational areas. There is a great diversity of outstanding natural features such as forests, meadows, marshes, shorelines, islands, streams, and lakes (both Great Lakes and inland). Many of these areas have exceptional scenic, wilderness, and aesthetic qualities which make them nationally significant. Recreational resources are not evenly distributed, being mostly located in the drainages of Lake Superior, Lake Ontario, and the northern parts of Lake Michigan and along the St. Lawrence River. In general, the sport fisheries and wildlife resources provide a major attraction for tourists which in turn provides for a multi-million dollar industry.

MOST PROBABLE FUTURE

This final report is prepared on the assumption that the Chief of Engineers' recommendations to the March 1976 Interim Feasibility Report would be implemented prior to initiation of recommendations in this final report. Therefore, commercial navigation on the upper four Great Lakes to

31 January ($\pm$ 2 weeks) is the "base condition" for this report and continuation thereof is considered to be the "MOST PROBABLE FUTURE," in addition to traditional intra-lake traffic movement. However, it is believed that without a firm Government commitment, the growth of season extension traffic would be spotty, haphazard and of a much lesser net benefit to the nation than that which will occur, given the condition of a firm Government investment in an extended season. This approach is predicated by the recent decision by the Office of Management and Budget (in a letter dated 9 March 1979 to the Secretary of the Army) that because the navigation season extension measures in the Interim Report would consist primarily of operation and maintenance activities, unlike traditional Corps of Engineers capital construction projects, and further, involve actions primarily by other Federal Agencies, it would be more appropriate for the involved agencies to propose actions needed to extend the season in each of their annual operating budgets, along with any needed specific authorization or appropriation language, rather than recommending Congressional "adoption" of the Interim Report. On the advice of the OMB, the Interim Report was forwarded on 3 August 1979 to the Congress, by the Secretary of the Army, for its information (House Document 96-181).

The March 1976 Interim Report recommends an extended season navigation on the upper four Great Lakes and their connecting channels to 31 January, ($\pm$ 2 weeks), depending on ice and weather conditions between non-ice restricted harbors. The 20 major United States harbors not restricted by ice (up to 31 January, $\pm$ 2 weeks) are as follows:

Lake Superior - Two Harbors, MN
- Taconite, MN
- Silver Bay, MN
- Presque Isle, MI
- Marquette, MI

Lake Michigan - Burns Harbor, IN
- Gary, IN
- Indiana, IN
- Milwaukee, WI
- Calumet, IL
- Muskegon, MI
- Ludington, MI

Lake Huron - Saginaw River

Detroit River - Detroit Harbor

Lake Erie - Toledo, OH
- Lorain, OH
- Cleveland, OH
- Ashtabula, OH
- Conneaut, OH
- Buffalo, NY

With the implementation of extended season navigation to 31 January ($\pm$ 2 weeks) on the upper four Great Lakes, savings would be realized: savings from transportation rate differentials between the Great Lakes/St. Lawrence Seaway and alternative transport modes; reduced stockpiling leading to savings in capital and handling costs; and savings by more efficient utilization of the existing vessel fleet which lower the annual freight rates for Great Lakes vessels.

In addition, with the implementation of the 31 January ($\pm$ 2 weeks) extended season, certain adverse impacts were identified. The impacts identified were those associated with disruption of ferry transportation at Sugar and Lime Islands in the St. Marys River and shoreline disruption in

the St. Marys River and the St. Clair River/Lake St. Clair/Detroit River System. Measures were included in the Chief of Engineers Report, dated 16 November 1977, to mitigate against these impacts.

The mitigative measures are as follows: an ice boom and bubbler-flusher for Sugar Island; an airboat for Lime Island; and shore structure protection and shore erosion protection above the ordinary high water mark for the St. Marys River, the St. Clair River, and the Detroit River for damages caused by extended season operations. Also, an environmental appraisal program, to be conducted concurrently with implementation of the first three years of operation to validate existing environmental assessments and to provide objective information for development of mitigative measures, if required, was included.

After 31 January (± 2 weeks) the Soo Locks would be shutdown, St. Marys River traffic would cease, and system-wide winter navigation would cease. Adverse impacts on shore structures and shoreline, not protected under the 31 January authorized protection, would be expected to continue due to natural conditions (i.e., thawing, winds).

In addition to the traffic that would move as a result of the 31 January (± 2 weeks) season extension, traditional intra-lake movement on Lakes Michigan and Erie and movement on the St. Clair River/Lake St.Clair/ Detroit River system is also expected to continue through the winter months. Vessel movement would be at the discretion of the shipping commpanies and largely dependent upon the severity of ice and winter conditions in the connecting channels, as well as in the ports of origin and destination. Icebreaking assistance would continue at an appropriate level.

The Canadian Welland Canal and its locks are expected to remain open to shippers as weather permits into the winter season to meet the reasonable demands of commerce.

Navigation on the St. Lawrence River would cease in accordance with the annually published operation and closing date procedures and/or when, in the judgement of the Seaway operating entities (St. Lawrence Seaway Development Corporation in the United States and the St. Lawrence Seaway Authority of Canada), ice and weather conditions preclude safe and efficient navigation on the St. Lawrence River. These decisions would also be coordinated with the power entities along the river - the Power Authority of the State of New York in the United States and Hydro-Electric Power Commission of Ontario.

PROBLEMS, NEEDS AND OPPORTUNITIES

Extended Navigation Season

This section of the report first addresses general problems common to most of the Great Lakes/St. Lawrence Seaway navigation system and then addresses specific problems in each lake and river involved. A detailed discussion is provided in Appendix A, Problem Identification. Solutions to these problems and alternatives considered are provided in Appendix B, Formulation of Detailed Plans.

System Problems

General environmental problems which could occur in localized areas of the Great Lakes and St. Lawrence Seaway System include: impacts on the physical environment, such as increased air pollution; decreased water quality; resuspension and redistribution of bottom sediments; increased turbidity; alteration of existing water levels, flows, and current patterns; shore vibrations caused by vessel movement through ice; and ice movement causing disruption of shoreline, littoral zone, and wetland vegetation. Possible impact on the biological environment includes: disruption of fish and wildlife habitats; changes to fish and wildlife

behavior patterns (i.e., fish spawning, fish/wildlife migration, etc.); alteration of fish and wildlife population densities; disruption, alteration, or destruction of benthic communities; and effects to endangered or threatened species. Also, possible impacts which could affect the social environment include: changes in existing and future recreational potential, including disruption of recreation activity areas, access, and events; changes in recreation use patterns, including reduction of man-days sport fishing effort and an increase in situations hazardous to the public, such as unsafe ice conditions; effects on occupational groups, such as individual safety and comfort, and "psycho-social" effects of an extended season; and disruption of cross channel transportation, although engineering solutions are developed to mitigate disruption to ferry services. Containment and recovery of oil and hazardous material and the environmental effects of accidental spills continue to be of major concern.

Solutions to many of the above environmental problems are considered in Appendix B (Formulation of Detailed Plans). Where the problems or solutions lack specificity, the procedures for identification, data gathering, analysis, and problem solving are further discussed in Appendix E (Environmental Plan of Action) and F (Environmental) along with the Final EIS which accompanies this Main Report.

Some general problems pertain to activities in which the Coast Guard is the main source of assistance. These include the need for icebreaking support in problem areas in lakes and rivers throughout the system. There is a need to collect up-to-date information on ice cover and weather conditions in problem areas and to get this information to shippers in time for effective use. Ships that become grounded and/or block navigation channels, and the oil spills that could possibly result, would present unique removal problems under severe winter conditions.

Solutions to this problem involve the increased use of existing communications systems for coordination between vessels and the Coast Guard

to form convoys, and to provide traffic control through problem areas, particularly the Soo Locks and St. Marys River. Also required are all-weather channel markers, navigation aids, aids to navigation, cold weather survival gear, all-weather life boats, and year-round search and rescue capabilities. Vessels should provide for safe and comfortable working facilities under winter weather conditions. Many vessels, such as the newer 1,000-foot bulk carriers in the Great Lakes fleet, have the structural and power capabilities to operate in ice.

On Lake Superior, open lake problems include windrowing, rafting, and shifting ice conditions that require constant surveillance and communications if these trouble areas are to be avoided.

St. Marys River problems involve operation and maintenance of the Soo Locks facilities under heavy ice conditions. Vessel traffic control and icebreaker assistance are necessary to convoy vessels through the tight turns and heavy ice concentrations in the lower river. A stable ice cover must be maintained in Soo Harbor to prevent ice jams from forming downstream into the Little Rapids Cut, where they can hamper navigation, prevent the Sugar Island ferry from operating, and cause levels to rise upstream in Soo Harbor. High levels in Soo Harbor could pose a flood threat to shoreline interests and the generators of the Edison Sault Electric Company's hydroelectric power plant. In addition, higher harbor levels could reduce the effective operating head for the three hydro-generating plants in the area--thereby reducing power generating output. Winter navigation also poses potential problems involving access to the four inhabited islands in the lower river, namely, Sugar, Neebish, Lime, and Drummond Islands. Other effects of winter navigation involve increased shoreline erosion and shore structure damage, vibration problems, and disruption to winter recreational activities.

Lakes Michigan-Huron experience ice problems similar to Lake Superior with rafting and shifting ice, particularly at harbor entrances and in

established navigation tracks. Heavy ice conditions are experienced at the northern end of the lakes and bays.

Vessel traffic in the St. Clair River is hampered by ice jams, which historically occur in the lower St. Clair River as a result of Lake Huron ice floes backing upstream from Lake St. Clair. The ice jams occasionally retard flow such that water levels rise upstream to cause flooding in low lying residential areas. In addition, build-up of ice in the lower river tends to cause shoreline erosion and shore structure damage. There is concern that winter navigation will cause additional quantities of ice to jam and compound problems in the lower river.

The natural retardation effect of the ice cover produces a natural regulation of the outflows. Water that would normally flow through the river under open water conditions is stored in the upper lake. The reduced outflow also reduces supply to the lower lakes (St. Clair and Erie), allowing their levels to drop throughout most of the winter. Since 1930, in the St. Clair River, the monthly average reduction in outflow due to ice is about 3,000 cfs for December, 27,000 cfs for January, 32,000 cfs for February 13,000 cfs for March, and 1,000 cfs for April. With an ice control system at the head of the river, this natural ice retardation might be reduced, which could result in more water passing through the river.

A similar problem exists in the Detroit River with the periodic eroding of the ice bridge that forms in Lake St. Clair. Generally, ice floes can pass through the Detroit River into Lake Erie unless easterly winds jam Lake Erie ice into the lower river. Floe ice can back up into the Detroit River to hamper navigation as far upstream as Detroit. There is concern that winter navigation may cause increased quantities of ice floes to enter the river.

Major ice problems in Lake Erie are caused by shifting ice conditions, particularly along the south shore harbor entrances and in the western

portion of the lake, where ice jams and ice ridges frequently halt vessel transit until icebreakers can reopen the track. During spring breakup, the loose ice may be blown into the eastern end of the lake where it turns into a heavy slush condition. Icebreaking and high powered vessels often have considerable difficulty moving through this type of ice.

Lake Ontario remains relatively ice free most of the winter with the exception of the eastern portion where prevailing winds tend to build the ice into thick ridges.

The St. Lawrence River is presently closed to winter navigation between Lake Ontario and Montreal Harbor. It is essential to maintain a stable ice cover above two hydroelectric generating stations to prevent ice jams and maintain adequate flow for power generation, and for purposes of meeting International Joint Commission criteria for the regulation of Lake Ontario. Ice booms, placed with the approval of the International Joint Commission, extend across the navigation channel during the winter months to form and help maintain the ice cover. Additional booms and modifications to existing booms would be required to allow ship passage and still maintain an ice cover. The ice cover formation periods occur at different times in two critical areas: usually mid - to late December in the reach upstream of the Beauharnois Powerhouse and about two weeks later above the Moses-Saunders Powerhouse. During both periods, it is necessary to reduce the river flow, and would probably require an interruption of navigation if the season is extended into these periods, in order to allow the ice cover to stabilize.

There are numerous areas where ice builds up to considerable thickness, causing problems for ship operation and to the operation of navigation locks around the power structures. It is anticipated that lock operation problems will be similar to those experienced at the Soo Locks.

On the St. Lawrence, shoreline erosion and increased damage to shore structures are expected to be similar to those experienced in other rivers during winter navigation.

Associated Problems

Associated problems include the need to determine liability for increased damage caused by winter navigation on shorelines and/or shore structures. In addition, there are legal questions hinging on the current liability of the power entities regarding the installation and use of ice booms to maintain a stable ice cover and uninterrupted flows through the St. Lawrence River. See Appendix J, Legal Considerations, for further discussion on this subject.

Another difficulty is assuring that ocean vessels would be controlled by pilots experienced in Great Lakes ice navigation.

The Need

Prior to 1960, the major obstacle in realizing winter navigation was not only ice in the system, but also the impracticability of handling frozen bulk cargo, especially iron ore. Additionally, the St. Lawrence Seaway was not developed to its present capability to handle oceangoing vessels.

The iron ore, hematite, obtained from the mines of Minnesota and Michigan prior to 1950, had an iron content as high as 68 percent. With the depletion of high grade ore, there was marginal economic benefit of mining and shipping the vast available quantities of lower grade ore, taconite. The development of the "taconite pellet process," by the University of Minnesota in the 1950's, by which taconite ore can be processed at the mines to attain pellets with a concentration of 63 percent

iron, again made production and transportation economical. The process also gives an added benefit--that is, a low moisture content which allows the pellets to be handled without freezing during cold weather.

The technological development of taconite pellets in the early 1950's, and the development of the St. Lawrence River to allow deep water ocean-going vessels to reach the ports of the Great Lakes and to provide dams and power facilities for electricity for New York, Vermont and Ontario, spurred and increased economic interest in the Fourth Seacoast of the United States during the 1960's. Congress, in 1965, authorized a study to determine if an extended navigation season on the Great Lakes/St. Lawrence Seaway were technically and economically feasible. The study, completed in 1969, concluded that technical and economic potential exists and recommended that a more detailed survey study be undertaken.

Resource and Kindred Problems

Based upon the above identified need, experience from the Demonstration Program, existing conditions, public involvement, and most probable future conditions, sets of resource management problems related to extended navigation were identified. Major navigation concerns associated with winter movement on the Great Lakes/St. Lawrence Seaway System involve four principal water navigation areas: (1) navigation channels and canals, both interlake and on the St. Lawrence River; (2) harbors; (3) locks; and (4) open courses. The four types are subject to a wide variety of icing conditions. Ice in the connecting channels, canals, and river channels severely limits vessel movement, especially at channel bends in restricted areas and where ice booms have been placed to control ice movement. Icing at harbor entrances, in harbor turning basins, in channels and at vessel berthing and docking areas hampers vessel maneuverability. Ice interference with lock operation is a major problem. Open lake ice and ice in the connecting channels and canals presents a danger to shipping because of the possibility of structural damage to vessel hulls.

Major Environmental and Social Concerns

Concerns relating to the bio-physical and social environments are as varied and geographically far-reaching as those of navigation. The following are major concerns that possibly interface with winter navigation.

Shoreline erosion. Shorelines (banks and beaches) and structures (boat docks, fishing piers, etc.), particularly along the St. Marys and St. Clair Rivers, are subject to deterioration (erosion and destruction) due to ice movement invoked by natural and man-made forces. Ice breaking and vessel movement can increase the forces against the ice and may increase the amount of deterioration.

Water quality. The overall water quality of the Great Lakes is perceived to have improved in recent years, resulting in an increased fishery and recreation use. Some areas, however, including Duluth-Superior Harbor, most shore areas near metropolitan areas, and the open waters of Lake Erie and Lake Ontario, remain below the national water quality standards. Added turbulence from vessel movement and pollution from potential spills may severely retard the general gains and further worsen sub-standard areas.

Water levels. In natural conditions, ice jams and hanging dams form in the channels and alter water levels and flows, causing spring flooding to communities and valuable wetlands. Such blockages most frequently occur in the connecting channels of the Great Lakes. Winter vessel movement and actions to maintain an open channel may reduce the stability of the ice cover, thus increasing the frequency of ice blockages and flooding.

Electric Generating Facilities. Linked to the concern of unstable ice cover and fluctuating flows, are the concerns of power generating plants

along the system which require extensive regulatory measures even under more natural winter conditions. The three thermo power generating plants on the St. Clair River have reported heavy ice blocking at their cooling water intakes. Continual navigation through the ice bridge at Port Huron, at the head of the St. Clair River, could increase the volume of river ice floes and increase this type of interference. On the St. Lawrence River, the power intakes require a given river discharge allowed by a stable ice cover. Winter vessel movement may disrupt the stable ice cover, reducing the river discharge and, coincidentally, the power generation at Moses-Saunders Station and Beauharnois Powerhouse.

Island transportation. A major or primary social concern related to winter navigation is the continuation of island-mainland transport links for Sugar, Neebish, Drummond, Lime and Harsens Islands residents. Under normal winter condition, island transport links are often tenuous from varying solidity of channel ice cover and ice blocking ferry crossings. Each of the islands have devised their own unique means of winter channel transport, thus establishing the islands as year-round communities. Winter vessel movement may disrupt the various methods of channel crossing. Island residents are concerned that transport disruption will affect social patterns, property values and the cost of channel crossings.

Environmental data. A major concern related to the proposed action is a lack of specific environmental data commonplace in comparable Corps studies. Searches for existing data, including contacts with universities, State agencies and Federal agencies concerned with fish and wildlife conservation in the area, yielded little existing information on winter phenomena. Data obtained treated limited geographic areas and parts of the Great Lakes winter ecosystem. Uncertainties persist, therefore, on a number of the facets of the ecosystem, such as breeding and migration of many aquatic species or the importance of frozen channels for wildlife migration. Efforts to obtain primary data, vis-a-vis Corps funded studies, have been curtailed by cost and time estimates beyond the intended purpose of this investigation.

PLANNING CONSTRAINTS

Planning constraints are based upon identified area resource management problems and specify limitations to direct plan formulation and restrict impacts. The constraints used in the formulation analysis are as follows:

a. Avoid or minimize damage to shorelines, structures and wetlands from vessel induced increased ice pressure or ice movement.

b. Avoid adverse effects to power plants by promoting a stable ice cover and the required river discharge.

c. Avoid adverse effects to low-lying communities from project-induced hanging dam and ice-jam flooding.

d. Avoid adverse impact to the overall water quality of the Great Lakes.

e. Avoid irreversible commitments of the environment prior to determining the ramifications of the proposed actions.

PLANNING OBJECTIVES

A set of planning objectives was formulated based upon the water and related resource management problems, needs and opportunities identified for the Great Lakes and St. Lawrence Seaway region. In addition to addressing the region's problems, the objectives listed below contribute to the national goals of national economic development (NED) and environmental quality (EQ). The following planning objectives served as general guidelines for the plan formulation process:

a. Promote efficient utilization of the navigation intrastructure of the Great Lakes/St. Lawrence Seaway system;

b. Contribute to an increase in output of goods, services and external economics of the Great Lakes/St. Lawrence Seaway system;

c. Contribute to the maintenance of the required water levels of the Great Lakes and discharge of the St. Lawrence River;

d. Maintain Great Lakes island settlements as viable social communities; and

e. Contribute to the quality of the Great Lakes/St. Lawrence Seaway environment, giving particular attention to the winter ecosystem and water quality of the lakes.

FORMULATING A PLAN

Formulating a plan for the extension of the navigation season is a single purpose planning process which develops and evaluates the feasibility of alternative plans for extending the navigation season on the Great Lakes/St. Lawrence Seaway.

A number of potential modifications to the navigation system are under long-range consideration through authorities separate from the authority for the extended navigation season investigation. These include the need for a new large lock at the St. Marys Falls Canal in Michigan, need for additional lock in the St. Lawrence River, and channel and harbor modifications, including potential deepening of the Great Lakes system. These studies as well as Season Extension would increase system capacity and improve national transportation efficiency. Our current work indicates that navigation season extension has the highest net benefits potential. Although there is some merit to combining all potential Great Lakes/St. Lawrence Seaway improvements into a system study, there is presently no authority to analyze season extension, lock replacement, and connecting channels on a common time frame. Therefore, these alternatives are not considered for this report. However, to avoid counting benefits that would be properly assigned to these other potential projects, season extension is analyzed recognizing the present system constraints of lock capacity, channel size and depth and harbor facilities.

FORMULATION AND EVALUATION CRITERIA

The formulation and evaluation of alternatives are done considering technical, economical, environmental, social, and institutional criteria to allow the development, comparison, and selection of plans that best respond to the problems and needs.

Technical Criteria Used Are:

a. Improvements should be adequate to accommodate expected user vessels for the economic life of the project which is amortized over a 50-year period;

b. Improvements should provide for optimum utilization of existing facilities;

c. Alternatives should allow for safe, efficient movement of expected user vessels;

d. Improvements should be sound, practicable, engineeringly feasible, and environmentally acceptable;

e. Technical solutions with the least adverse environmental impacts should be used; and,

f. If necessary, corrective and/or mitigative measures should be made part of the engineering solutions.

Economic Criteria Used Are:

a. Project dollar benefits should exceed project dollar costs;

b. Separable units of improvement should provide dollar benefits at least equal to its dollar cost;

c. The scope of the development should be such as to provide --certainly identify--the maximum net benefits;

d. Annual costs including operation and maintenance should be based upon a 50-year period of economic life and an interest rate of 7-1/8 percent based on October 1979 price levels;

e. There should be no more economically or environmentally acceptable means of accomplishing the same purpose or purposes that would be precluded from development if the plan were undertaken; and,

f. Projected project disbenefits, and environmental and social costs must be included, and if possible, quantified.

Environmental Criteria Used Are:

a. Provide for management, protection, or enhancement of ecological systems;

b. Provide for management, preservation, or enhancement of specially valuable or outstanding archaeolcgical, historical, biological, or geological resources;

c. Provide for enhancement of quality aspects of water, land, and air by control of pollution or prevention of erosion and restoration of already eroded areas caused by winter navigation;

d. Provide for management, protection, or enhancement of aesthetic areas; and,

e. Provide for avoidance of unnecessary irreversible commitment of resources to future use.

Social Criteria Use Are:

a. Avoid unnecessary and/or unreasonable risk of loss of life and hazard to health and safety;

b. Preserve or enhance social, cultural, educational, and historical values;

c. Avoid disruption of man-made or natural resources, aesthetic values, community cohesion, and public facilities and services;

d. Consider human environmental benefits and costs equal in status to monetary units;

e. Identify possible employment effects and changes to tax and property values;

f. Coordinate alternatives with local, regional and state interests; and,

g. Evaluate public acceptance of proposed modifications and ability and willingness to meet local requirements.

Institutional Criteria Used Are:

a. Institutional requirements imposed by alternative plans must be an integral part of the project plan formulation process;

b. Coordination should be carried out with existing Federal, state, and local institutions that are operating in or have an interest in the study area;

c. Areas of responsibility of Federal, State, and local institutions should be defined; and,

d. Improvements proposed should be institutionally implementable.

PLAN DEVELOPMENT (NED + EQ)

Congress has requested that the Corps of Engineers investigate the feasibility of ways and means of extending the navigation season on the Great Lakes-St. Lawrence Seaway System and to determine the degree of Federal participation, if any. The first step in the planning process is problem identification, where information is obtained from the public and agencies about the needs (opportunities and problems) which the study could address. From these needs are derived a set of planning objectives for the study. To help insure that the best overall plan is developed, a range of alternative plans are developed to address the planning objectives and then evaluated. As part of the plan development process, a plan to optimize National Economic Development (NED) and maximize net economic benefits, and at least one plan to maximize Environmental Quality (EQ Oreinted) contributions, need to be developed.

In March 1976 an Interim Feasibility Report was prepared. Three alternative plans were developed, analyzed, and evaluated addressing the feasibility of extended season navigation on the entire Great Lakes-St. Lawrence Seaway System. These were Traditional Navigation Season, Fixed Navigation Season, and Extended Navigation Season. This analysis is presented in Attachment 1 to Appendix B. Based on the analysis and evaluation of the three alternative plans, the Selected Plan in the Interim Report is Extended Navigation Season. It is also designated as the National Economic Development (NED) plan. For the Interim Feasibility Report a fixed Navigation Season was designated as the Environmental Quality (EQ Oriented) Plan.

Under the Selected Plan of the referenced Interim Report, three alternative proposals for extending the navigation season beyond 15 December on the entire system were developed and analyzed - extension to 31 January, 28 February, and 31 March (year-round). Extension of the navigation season was recommended in the Interim Feasibility Report, on only the upper four Great Lakes to 31 January (± 2 weeks) using only

existing operational measures, with little or no new construction. This recommendation was based upon economic, environmental, social and engineering information and data as of March 1976 and actual experience (i.e., commercial vessel movement) during the five years of the Demonstration Program between 1971 and 1976. This report was transmitted to Congress for its information on 3 August 1979 (House Document No. 96-181). Office of Management and Budget has taken the position that agencies have the authority to operate through 31 January ($\pm$ 2 weeks).

Since 1976, additional economic, environmental, social and engineering data collection and analysis have been conducted to further evaluate the viability and continued progressive development of the Selected Plan.

As part of further plan development of the Selected Plan this Final Survey Report presents and analyzes, six additional proposals for further extension of the navigation season throughout the system (see Table 1) in addition to the Base Condition Plan, on both a geographic and time extension basis, to 12 months on the upper four Great Lakes and 11-month navigation on the Welland Canal-Lake Ontario-St. Lawrence River portion of the system. Year-round navigation on the upper four Great Lakes is made possible by having at least two locks (Poe and MacArthur Locks) available for operation at Sault Ste. Marie. Maintenance at the locks would be phased to enable continuous operation of vessels through the lock facilities. When the Poe Lock is down for major maintenance--currently scheduled for every 5 years--the 105 foot beam vessels would not be able to transit the Soo Lock facilities; however, operation of the 767 foot by 76 foot vessels could continue. A phased maintenance program would be designed to minimize the down time of the Poe Lock so as not to restrict the larger vessels.

On the St. Lawrence Seaway portion of the system, up to an 11-month navigation season is the maximum considered possible at this time. There are adjacent locks at only three of the fifteen lock facilities on the

TABLE 1

SEASON EXTENSION PROPOSALS[1/]

Extended Season Proposals	Estimated Starting Date of Vessel Operations	Lake Superior St. Marys River Lake Michigan Straits of Mackinac Lake Huron	St. Clair River Lake St. Clair Detroit River Lake Erie	Welland Canal Lake Ontario St. Lawrence River
Base Condition	Prior to 1987	1 Apr - 31 Jan	1 Apr - 31 Jan	1 Apr - 15 Dec
1.	1987	Year-round	1 Apr - 31 Jan	1 Apr - 15 Dec
2.	1990	Year-round	1 Apr - 31 Jan	1 Apr - 31 Dec
3.	1990	Year-round	Year-round	1 Apr - 31 Dec
4.	1992	Year-round	Year-round	20 Mar - 31 Dec
5.	1995	Year-round	Year-round	7 Mar - 7 Jan
6.	2000	Year-round	Year-round	7 Feb - 7 Jan

NOTE: The Chief of Engineers' recommendation on the March 1976 Interim Feasibility Report recommends an extended season program on the upper four Great Lakes to 31 January (± 2 weeks). This is the Base Condition shown above.

1/ The word "proposal" identifies sub-divisions of an overall plan. These proposals have not been developed as exclusive alternatives.

Welland Canal and St. Lawrence River; therefore, at this time, at least one month of down time for maintenance is contemplated during the winter months. The St. Lawrence Seaway Development Corporation of the United States and the St. Lawrence Seaway Authority of Canada are currently investigating the possibilities of phasing their lock maintenance programs on the Welland Canal and the St. Lawrence River over the entire year, rather than performing maintenance only during the winter, which is the current mode of operation. If the U.S. and Canadian Governments are able to develop such a lock maintenance program, year-round season extension on the entire Great Lakes-St. Lawrence Seaway System could be feasible without lock twinning. However, for purposes of this analysis, it is assumed that season extension beyond 11 months on the St. Lawrence River would definitely require twinning of the Welland and St. Lawrence River Locks to permit lock maintenance. Therefore, potential year-round season extension is currently limited to the upper four Great Lakes only. Phasing of the lock maintenance program at the Soo Locks at Sault Ste. Marie, Michigan, to permit year-round navigation on the upper four Great Lakes is considered feasible to make year-round operation possible.

In addition to the development of the six proposals (or possibilities), further consideration is given to the definition of the National Economic Development (NED) plan and the Environmental Quality (EQ Oriented) Plan, consistent with the U.S. Army Corps of Engineers Policies and Procedures.

NED Plan

The NED Plan addresses the planning objectives of the study in a way to maximize net economic benefits. This plan consists of both non-structural and structural improvements to permit a permanent extension of the navigation season to 12 months on the upper four Great Lakes and up to 11 months on Lake Ontario and the International Section of the St. Lawrence River. Since 1976, additional analysis has been given to improvements to

enhance the efficiency of operation of a permanent system-wide extended navigation season program, and the net economic benefits that could be realized are maximized with this plan as compared to the other alternatives. It is important to note that this plan provides for monetary compensation and mitigation, such as island transportation assistance and shoreline protection, for those environmental/social impacts which have been positively identified from actual operations, during the Demonstration Program and further detailed analyses accomplished since the 1976 Interim Feasibility Report.

EQ (Oriented) Plan

The Environmental Quality (EQ) Plan is that alternative which addresses the planning objectives in such a manner as to make net positive benefits to the EQ account. This requires analyzing the overall environmental contributions of each alternative in comparison with the most probable future conditions without a project. If it is impossible to designate an EQ (Oriented) Plan that meets these requirements, the alternative least damaging to the environment will be identified.

The EQ Plan for the Great Lakes and St. Lawrence Seaway navigation season extension consists of four basic components: (1) a permanent extension of the navigation season up to 12 months on the upper four Great Lakes, instituted through a phased implementation procedure; (2) an extension up to 11 months on Lake Ontario and the International Section of the St. Lawrence River instituted through a phased implementation procedure; (3) the accomplishment of a system inventory and evaluation of the environmental impacts induced by extended season navigation; and (4) monitoring of certain environmental parameters during winter operation.

The extension of the navigation season for the two geographic components would be physically promoted by both structural (icebreakers, bubblers) and non-structural (vessel speed control) measures. The bulk of

the justification of the EQ (Oriented) Plan lies in the environmental considerations commensurate with navigation measures and the benefits yielded: (1) phasing implementation over time and space to allow environmental investigations and prevent irreversible commitment of the environment prior to ascertaining ramifications; (2) increasing the environmental knowledge by means of a system inventory; (3) assessing impacts from a more comprehensive environmental base; (4) monitoring environmental parameters during winter operation; (5) promoting better management of the ecosystem by increasing knowledge of it; and (6) modifying the operation of the project in response to an adverse impact.

This plan provides for an "ADAPTIVE METHOD" for determining the environmental feasibility and taking action to address potential impacts of an extended navigation season program, to be accomplished concurrently with the continued planning, design, and implementation of an authorized program. The approach consists of implementing an Environmental Plan of Action for environmental base condition data collection, evaluation and assessment, monitoring, and validation--including environmental compensation, mitigation and possibly enhancement--to be done concurrently with the continued planning, advanced engineering and design, construction, and operation phases of the program to ensure environmental compatibility.

The plan of action, to be implemented in conjunction with each major segment of the project during the first 10 to 15 years of the project, would be designed to provide assurance that winter navigation would be conducted in an environmentally acceptable manner, with provisions made for accomplishing any necessary corrective or mitigative actions, including the halting or limiting of vessel traffic if necessary.

These benefits to the environment are measured against those that would occur in the most probable future condition - extension of navigation to 31 January (± 2 weeks) by economic pressure and few overt federal actions. Under such circumstances, the potential for some dramatic adverse impacts

would exist (accidental spills and possible shore erosion), but would not have the benefits of inventory monitoring or management.

Summary Comparison

The purpose of the Summary Comparison is to present the alternate plans of action, and the crucial and determinative factors that underlie each final alternative relative to plan objectives and final selection. This Summary Comparison is brief and is intended to address only those effects which are considered significant.

The three alternate plans are:

1. No Action (or "Without Condition") Plan
2. National Economic Development (NED) Plan
3. Environmental Quality Oriented (EQ) Plan

The No Action (or "Without Condition") Plan is a non-structural plan and involves no planned season extension, with no extension beyond 31 January and until 1 April. Of the three alternate plans, the No Action Plan is the most acceptable to the general public, specifically the riparians. However, the No Action Plan does not meet any of the report objectives--it does not further contribute to the full utilization of the Great Lakes fleet, and as it does not increase National economic or regional development, this plan has the lowest net economic benefits of the three plans considered. While the No Action Plan does not add to adverse environmental or social well-being effects beyond those which occur during traditional winter navigation, it does little by comparison to provide for any precautionary or mitigative measures to insure against or correct these effects. The No Action Plan does not have the benefits of environmental inventory, monitoring, or resource managment techniques.

The NED Plan consists of both structural and non-structural improvements to permit a technically feasible permanent extension of the navigation season to 12 months on the upper four Great Lakes and up to 11 months on the U.S. portion of the Welland Canal-Lake Ontario-St. Lawrence River reach of the system. Of the three plans, the NED Plan achieves the highest B/C ratio and maximizes net economic benefits. Economic benefits would be realized through transportation efficiency, stockpiling savings, and through an increase in employment. The NED Plan best meets the project criteria while maintaining lowest project costs. Regional development increases as well as system capacity, and the NED Plan provides for improved national transportation efficiency and some energy savings. Optimum utilization of existing facilities and the Great Lakes fleet is accomplished.

The significant adverse effects of the NED Plan are in the environmental categories. Beneficial environmental effects of the NED Plan would be minimal. While some compensation and mitigation are provided in this plan (island transportation assistance and shoreline protection--those impacts identified in actual operations), no environmental baseline studies or on-going mitigation methods are implemented. Without environmental baseline data, a determination of compliance with Michigan's Coastal Zone Management Plan would be improbable. Most environmental parameters would be adversely affected through the NED Plan, including water and air quality, fisheries, wildlife, and benthic communities. While the plan would reduce hazards to crews, most social well-being concerns would be adversely impacted, i.e., noise, cross-channel transportation, and aesthetic values.

The Environmental Quality Oriented Plan applies to the same geography and timeframe as the NED Plan. This plan is technically feasible and the most environmentally acceptable of the three alternate plans. The EQ Oriented Plan emphasizes maintenance and enhancement of environmental quality, and most importantly, implements the Adaptive Method as described in the Main Report. If impacts are considered to be unacceptable, measures

would be taken to mitigate, compensate, or eliminate the impact, even to the point of ceasing operation. Management, protection, and enhancement of ecological systems are provided, and as such, this plan best meets environmental project criteria, at a high B/C ratio. The EQ Oriented Plan provides for reversibility and, unlike the NED Plan, environmental investigations would take place to establish ecological baseline data.

This plan would be more likely to meet compliance with Michigan's Coastal Zone Plan. The environmental studies will make the EQ Oriented Plan more costly than the NED Plan, but benefits would remain high relative to costs.

The detailed System of Accounts of the three alternate plans is presented in Appendix B. The System of Accounts and Summary Comparison of the March 1976 Report are found in Appendix B, and relate Traditional Navigation Season, Fixed Navigation Season and Extended Navigation Season as the three alternate plans.

PHASED IMPLEMENTATION

Because of the complexity and vastness of the Great Lakes-St. Lawrence Seaway System and the need for Canadian co-participation, phased implementation of the project is considered absolutely necessary. This particularly applies to the St. Clair and Detroit River system, Welland Canal (all Canadian), and the St. Lawrence River, a major part of which is wholly in Canada. On the St. Clair and Detroit River systems, improvements being recommended for these reaches are necessary to minimize risks cross the international boundary. Without Canadian co-participation in the Welland Canal, on the Canadian reach and International section of the St. Lawrence River, navigation season extension on the total Great Lakes/St. Lawrence Seaway system cannot be realized.

This report is based upon the assumption that the recommendations in the Chief of Engineers Report, dated 16 November 1977, which was transmitted to Congress for its information on 3 August 1979 (House Document No. 96-181), would be implemented prior to initiation of the recommendations in this report.

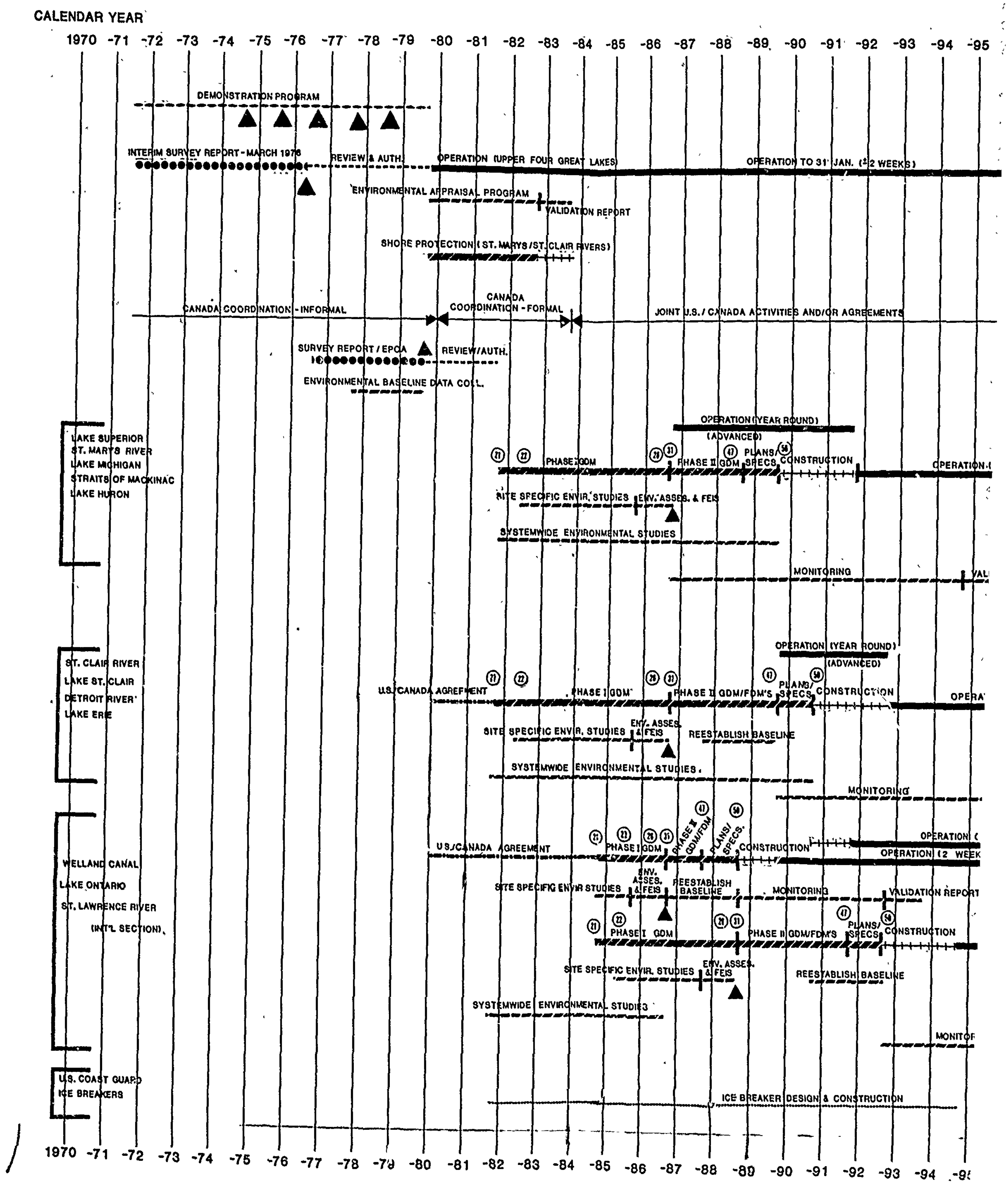
Phased implementation means the implementation of a permanent navigation season program above and beyond the base condition in this report in a selected time and geographical sequence. This sequence is the same as the one displayed in Table 1 and is displayed graphically in Figure 2. Season extension would likely be implemented in the same sequence as Proposal 1 through Proposal 6. Benefit-cost analyses have been done for each of the six proposals and are displayed in detail in Appendix D - Economic Benefits and Costs. It shows incremental justification for the step-by-step or phased implementation process.

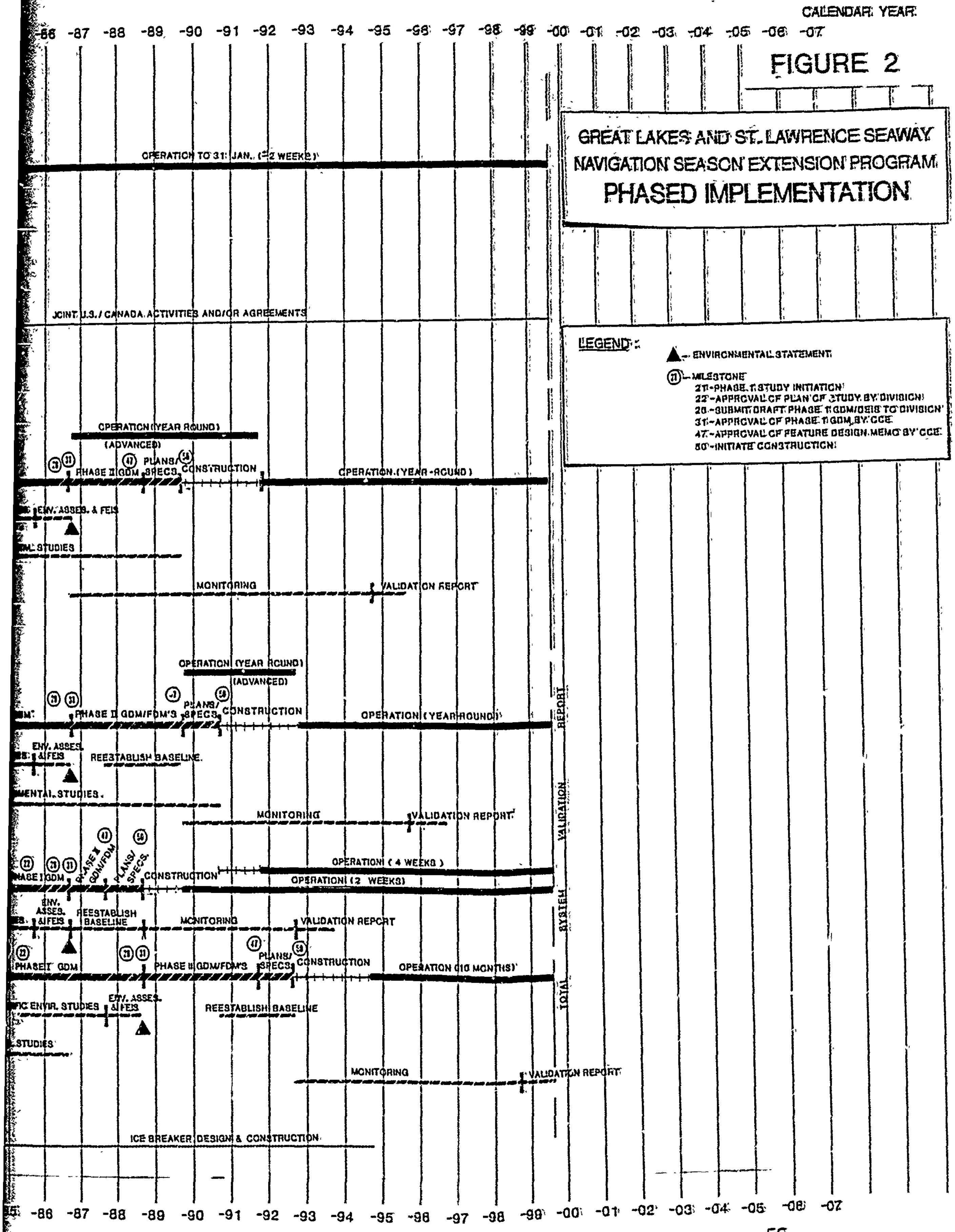
The actual procedure for implementation of activities associated with each phase is described in the section entitled "Adaptive Method."

The first phase (Proposal 1) would be implementation of those measures required for year-round navigation on the upper three Great Lakes (Superior, Michigan and Huron). It should be noted that after environmental investigations are concluded and the environmental statement submitted for the Phase I General Design Memorandum, existing facilities may allow for early vessel operations in advance of completion of construction of all improvements for this phase.

The second phase (Proposal 2) would be implementation of measures required to provide a 15-day extended closing on the Welland Canal-Lake Ontario-St. Lawrence River reach to 31 December.

The third phase (Proposal 3) would be the implementation of measures required to provide up to year-round navigation on the St. Clair/Detroit Rivers and Lake Erie.


CALENDAR YEAR
1970 -71 -72 -73 -74 -75 -76 -77 -78 -79 -80 -81 -82 -83 -84 -85 -86 -87 -88 -89 -90 -91 -92 -93 -94 -95
DEMONSTRATION PROGRAM
INTERIM SURVEY REPORT - MARCH 1976
REVIEW & AUTH.
OPERATION (UPPER FOUR GREAT LAKES)
OPERATION TO 31 JAN. (±2 WEEKS)
ENVIRONMENTAL APPRAISAL PROGRAM
VALIDATION REPORT
SHORE PROTECTION (ST. MARYS/ST. CLAIR RIVERS)
CANADA COORDINATION - INFORMAL
CANADA COORDINATION - FORMAL
JOINT U.S./CANADA ACTIVITIES AND/OR AGREEMENTS
SURVEY REPORT / EPCA
REVIEW/AUTH.
ENVIRONMENTAL BASELINE DATA COLL.
LAKE SUPERIOR
ST. MARYS RIVER
LAKE MICHIGAN
STRAITS OF MACKINAC
LAKE HURON
OPERATION (YEAR ROUND)
(ADVANCED)
PHASE I GDM
PHASE II GDM
PLANS/ SPECS
CONSTRUCTION
OPERATION
SITE SPECIFIC ENVIR. STUDIES
ENV. ASSES. & FEIS
SYSTEMWIDE ENVIRONMENTAL STUDIES
MONITORING
ST. CLAIR RIVER
LAKE ST. CLAIR
DETROIT RIVER
LAKE ERIE
U.S./CANADA AGREEMENT
PHASE I GDM
PHASE II GDM/FDM'S
REESTABLISH BASELINE
WELLAND CANAL
LAKE ONTARIO
ST. LAWRENCE RIVER
(INT'L SECTION)
PHASE II GDM/FDM
PLANS/ SPECS.
OPERATION (2 WEEK
VALIDATION REPORT
U.S. COAST GUARD
ICE BREAKERS
ICE BREAKER DESIGN & CONSTRUCTION
1970 -71 -72 -73 -74 -75 -76 -77 -78 -79 -80 -81 -82 -83 -84 -85 -86 -87 -88 -89 -90 -91 -92 -93 -94 -95


CALENDAR YEAR
-86 -87 -88 -89 -90 -91 -92 -93 -94 -95 -96 -97 -98 -99 -00 -01 -02 -03 -04 -05 -06 -07
FIGURE 2
GREAT LAKES AND ST. LAWRENCE SEAWAY
NAVIGATION SEASON EXTENSION PROGRAM
PHASED IMPLEMENTATION
OPERATION TO 31 JAN. (±2 WEEKS)
JOINT U.S. / CANADA ACTIVITIES AND/OR AGREEMENTS
LEGEND:
ENVIRONMENTAL STATEMENT
MILESTONE
21-PHASE I STUDY INITIATION
22-APPROVAL OF PLAN OF STUDY BY DIVISION
26-SUBMIT DRAFT PHASE I GDM/DEIS TO DIVISION
31-APPROVAL OF PHASE I GDM BY CCE
47-APPROVAL OF FEATURE DESIGN MEMO BY CCE
50-INITIATE CONSTRUCTION
OPERATION (YEAR ROUND)
(ADVANCED)
PHASE II GDM
PLANS/SPECS.
CONSTRUCTION
OPERATION (YEAR-ROUND)
ENV. ASSES. & FEIS
STUDIES
MONITORING
VALIDATION REPORT
OPERATION (YEAR ROUND)
(ADVANCED)
PHASE II GDM/FDM'S
PLANS/SPECS.
CONSTRUCTION
OPERATION (YEAR ROUND)
ENV. ASSES. & FEIS
REESTABLISH BASELINE
ENTAL STUDIES
MONITORING
VALIDATION REPORT
PHASE I GDM
PHASE II GDM/FDM
PLANS/SPECS.
CONSTRUCTION
OPERATION (4 WEEKS)
OPERATION (2 WEEKS)
ENV. ASSES. & FEIS
REESTABLISH BASELINE
MONITORING
VALIDATION REPORT
PHASE I GDM
PHASE II GDM/FDM'S
PLANS/SPECS.
CONSTRUCTION
OPERATION (10 MONTHS)
IC ENVIR. STUDIES
ENV. ASSES. & FEIS
REESTABLISH BASELINE
STUDIES
MONITORING
VALIDATION REPORT
ICE BREAKER DESIGN & CONSTRUCTION
TOTAL SYSTEM VALIDATION REPORT
-86 -87 -88 -89 -90 -91 -92 -93 -94 -95 -96 -97 -98 -99 -00 -01 -02 -03 -04 -05 -06 -07

The fourth phase (Proposal 4) would be the implementation of measures required to provide for approximately an eleven day early opening starting 20 March on the St. Lawrence River and use of the Welland Canal.

The fifth phase (Proposal 5) considers 10-month navigation from approximately 7 March to 7 January on the St. Lawrence River portion of the system and use of the Welland Canal.

The sixth phase (Proposal 6) considers 11-month navigation on the St. Lawrence River from approximately 7 February to 7 January, and use of the Welland Canal.

ADAPTIVE METHOD

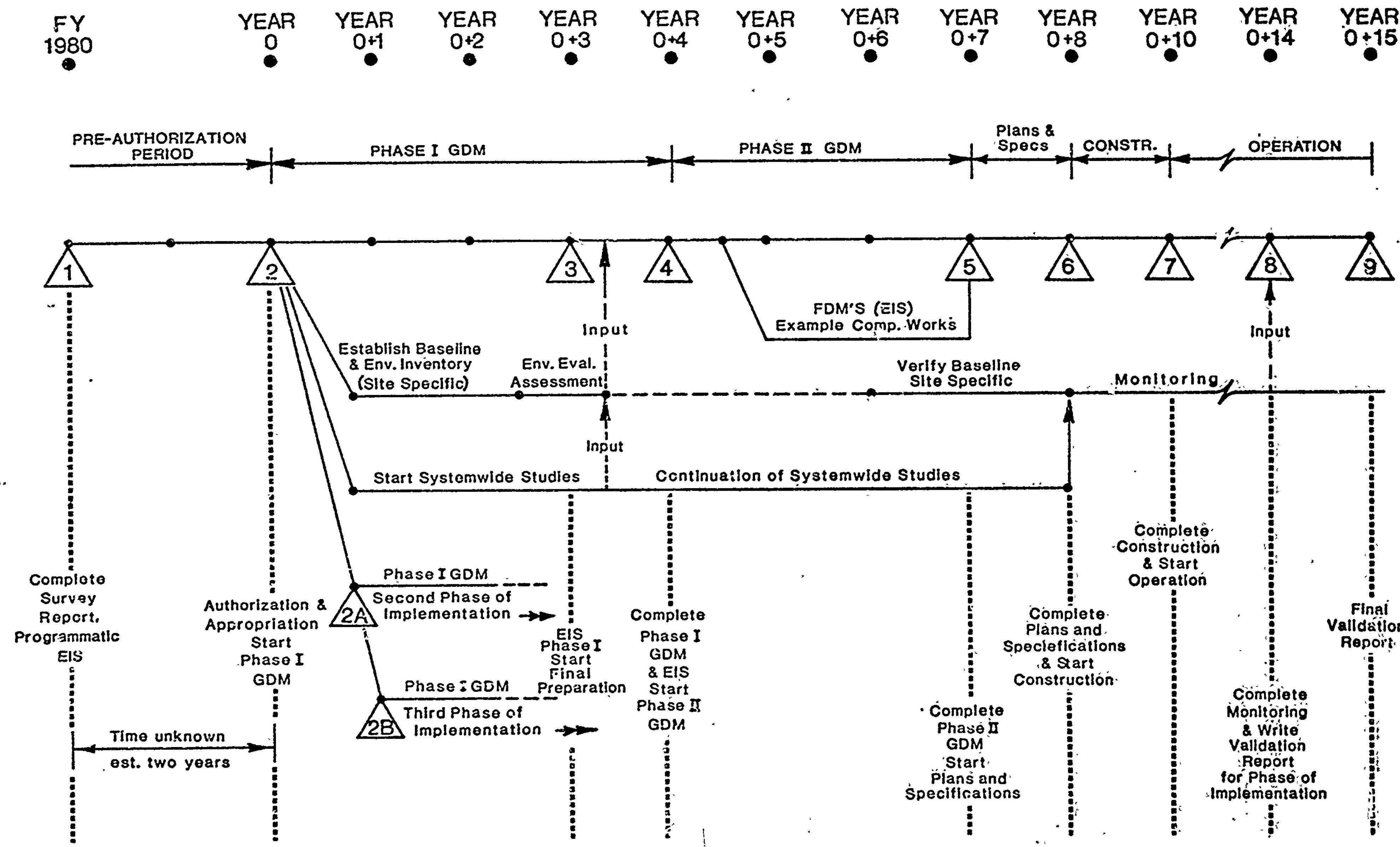
The Environmental Impact Statement (EIS) accompanying this Survey Report is programmatic in nature in that it addresses the impacts of the entire Navigation Season Program on a regional scale while describing the program of follow-on studies, described in an Environmental Plan of Action (EPOA) for determining details of site-specific and system-wide impacts at appropriate times following authorization of the Program as planning continues, engineering and design are accomplished, and before, during, and after construction and operation activities take place. The EIS, because of its programmatic nature, is also able to address potential, perceived, and unforeseen impacts and provides a proposed plan for determining which of these might actually occur. The EIS, by means of this EPOA, presents the environmental program for best assuring that the environment of the Great Lakes System would be protected adequately during development of an Extended Navigation Season Program. The environmental program contains a plan called the Adaptive Method, which provides the necessary checks and balances to best assure protection or enhancement of the environment as planning continues and before, during, and after construction and operation activities take place. Predictions of environmental impacts would be accomplished through the use of U.S. Fish and Wildlife Service Assessment

Methodology Technique, which is an integral part of the Environmental Plan of Action. For the level of detail available for this Survey Report, the Programmatic EIS is considered adequate and appropriate.

An understanding of the Adaptive Method can best be gained through reviewing the text below and referring to the diagram in Figure 3. That diagram outlines the plan, showing basic time frames, reports required, and inherent checks and balances. Along the time line are a number of points where activities take place and important decisions have to be made.

Triangle 1 represents completion of this Survey Report which is scheduled for early 1980. Triangle 2 represents an anticipated Congressional authorization and appropriation of funds which could occur about 1982, should Congress authorize the recommended plan for continued planning, design, and construction. Since the actual time for such authorization is unknown, the schedule on the diagram designates this point as year zero for scheduling subsequent activities and reports.

At year zero, following appropriations, the Corps of Engineers (COE) would begin several geographically oriented detailed planning studies--called Phase I General Design Memorandums (GDM's)--concurrently with obtaining environmental baseline and inventory data and initiating the system-wide and site specific studies. After a period of up to 3 to 5 years, sufficient information (environmental, engineering, etc.) would be developed to make engineering decisions and to allow final preparation of the integrated environmental, economic, and engineering decision-making document. This document is called an Environmental Impact Statement (EIS) which would accompany its mutually supporting Phase I GDM to higher COE authority for approval. This EIS would be based on evaluation of the baseline data from both site specific and system-wide studies. Using the Fish and Wildlife Service's (FWS) Assessment Methodology Technique, the EIS would predict all impacts known at that time resulting from the Extended



ADAPTIVE METHOD DIAGRAM

FIGURE 3

Navigation Season Program. It would also provide details on monitoring considered necessary to guard against unanticipated adverse impacts. On the diagram, the assessment and impact prediction would occur between Triangles 3 and 4.

Also, key to understanding the COE Adaptive Method is the commitment that should the assessment indicate a need, the design of an item or planned activity could be modified during Plase I planning to mitigate, compensate, or eliminate adverse impacts.

After approval of the Phase I GDM and EIS, Phase II GDM studies would begin which are detailed engineering design studies leading to preparation of plans and specifications. System-wide environmental studies would continue during this period. At some point, about two years before any construction is scheduled to begin (Triangle 6), the environmental baseline would be verified and updated in preparation for monitoring during construction and operation. Should the design be significantly altered or new information be developed (showing a probability of a previously unanticipated impact), an appropriate update to the EIS would be prepared prior to construction. In addition, it is likely that for a major construction activity, such as compensating works, a Feature Design Memorandum (FDM) would be prepared. This FDM would describe only one item of construction and could also require the preparation of an environmental assessment or EIS (if the structure were altered significantly from previously described plans or if new potential impacts of the structure came to light since the previous EIS was completed).

During construction and operation (Triangles 7 through 9), environmental monitoring would be accomplished as a check on impact predictions and as a safeguard against unanticipated adverse impacts. The monitoring would compare the post-construction environmental base conditions with pre-constructaon conditions. This would detect subtle or cumulative impacts. Should the monitoring indicate that a significant

impact is occurring, any of several things would be done depending on the nature of the impact. If the impact was found unacceptable, the cause would be eliminated, even to the halting of vessel traffic. If a lesser measure would accomplish a satisfactory result, it would be done. If an impact develops which is considered acceptable but undesirable, appropriate measures would be taken to mitigate, compensate, or eliminate the impact without halting vessel transits.

There would be several Phase I (GDM) studies and EIS's running concurrently, but these would not necessarily be started simultaneously. The diagram, for clarity, shows only one phase of the recommended implementation and represents the effort needed for year-round navigation on the upper four Great Lakes. An example of another phase of implementation would be that of achieving 10-month navigation on the St. Lawrence River.

A Validation Report would be completed for each phase of implementation. A Final Validation Report would be written summarizing all preceding reports. These would be prepared after monitoring indicated that all impacts had been identified and evaluated and all efforts at compensating, eliminating, or mitigating impacts had been taken. The Validation Reports would review the information obtained and re ommended whether or not operation should continue. The Final Validation Report would provide the answer on the environmental acceptability of the extended navigation season program or any phase of the program.

Variations From Project Implementation Procedures

The Adaptive Method process differs from standard COE procedures in four (4) areas:

(1) The Environmental Impact Statement (EIS) is programmatic in nature and addresses the environmental impacts at a level of detail commensurate

with the engineering studies. The programmatic EIS addresses impacts on a regional scale and describes the program for determining details of site-specific and system-wide impacts at appropriate times during post-authorization and pre-construction studies which would address affirmation or reformulation, if necessary.

(2) The U.S. Fish and Wildlife Service's Environmental Assessment Technique is employed to extend the customary assessment process, made in the planning phase, through construction and operation. It places increased emphasis on responding to unforeseen adverse impacts that occur during detailed design, construction, and operation of the project. This technique should provide for better management responses to unanticipated adverse environmental impacts.

(3) The Validation Report is a summary of evaluations and conclusions reached during the monitoring phase of the Program. This is a new type of report, not previously accomplished in COE studies, and would be provided to the Congress. It would provide a vehicle for recommending that the extended navigation season program be continued, modified, or halted, based upon monitoring of environmental impacts.

(4) The estimated cost of environmental studies is $126 million, and is higher than that previously experienced for site-specific, water resources development projects. The factors which contribute to the cost are a lack of adequate information on the Great Lakes/St. Lawrence River winter ecosystems, other effects associated with navigation through ice, and the magnitude and importance of the resource.

EVALUATION OF PROPOSALS

Economic Benefits and Costs

The economic feasibility of each of the six proposals to extend the navigation season was determined by comparing equivalent average annual charges; i.e., interest, amortization, and operations and maintenance costs, with an estimate of the average transportation-related annual benefits that would accrue over the selected 1987-2037 period of analysis. The value given to benefits and costs at the time of their accrual was made comparable by conversion to an equivalent time basis using an interest rate of 7-1/8 percent, the current rate applicable to public projects. Costs are based on October 1979 price levels. It is suggested that the reader review Appendix D, Economic Benefits and Cost, for a detailed description of the economic analysis. No estimate of operational costs has been developed for operating the Welland Canal or Canadian St. Lawrence River locks and channels. Should the Canadian government participate in the extended season program, it is assumed they will operate the Welland Canal and the Canadian St. Lawrence locks and channels. However, the economic evaluation in this report is based solely on U.S. vessel and U.S. harbors related interests. Benefits accrued by Canadian vessels, harbors and shipping interests have not been computed.

Costs of Navigation Season Extension

The entire U.S. portion of the Great Lakes/St. Lawrence Seaway System was analyzed as to the problems and requirements considered necessary to extend the navigation season in the following areas: (1) each of the five Great Lakes; (2) Great Lakes Connecting Channels; (3) locks in the St. Marys River and International section of the St. Lawrence River; (4) harbors in the entire system; and (5) the St. Lawrence River. A summary of activities necessary to extend navigation season throughout the system is shown in Table B-3 of Appendix B. Costs were derived for all the

activities required for each of the six proposals to extend the navigation season throughout the system. In establishing the United States' costs on the Great Lakes boundary waters, two assumptions are made: (1) for the St. Lawrence River, the U.S. will pay 100% of all improvements within U.S. territorial area and 50% of the total cost for facilities bridging the International boundary. In turn, it is assumed that Canada will pay 100% for improvements within its territorial boundaries, and 50% of the total cost for facilities bridging the International boundary; (2) for the St. Clair River-Lake St. Clair-Detroit River System, the U.S. would pay 50% for required ice control structures and compensating works in the system. The U.S./Canada cost split is an initial assumption and is subject to negotiations between the Governments.

Benefits of Navigation Season Extension

Substantial benefits would result from extending the navigation season on the Great Lakes/St. Lawrence Seaway System (GL/SLS). First, shippers of GL/SLS waterborne commerce will have the less costly water transportation alternative open to them for an extended period. This would result in transportation rate savings based on the differentials between GL/SLS winter waterborne rates and alternative overland rates.

The second major area of savings stems from the more efficient utilization of the existing Great Lakes fleet mix under normal winter operations. Navigation season extension provides a greater annual return on the capital invested in ships. Even though variable costs such as fuel and labor may increase with winter navigation, these increases are more than offset by the increased number of loaded trips over which to spread capital costs. Thus, whereas transportation rate savings result from a new least cost alternative defined in terms of existing waterborne and rail rate structures, winter rate savings result from efficiencies in using the current Great Lakes fleet, which lowers the annual freight rate for ships operating in the lakes.

TABLE 2

AVERAGE ANNUAL BENEFITS AND COSTS (IN $1,000 at 7-1/8%) 24 HOUR OPERATION ON WELLAND-SEAWAY IN WINTER

Avg Annual Benefits	PROPOSAL 1	PROPOSAL 2	PROPOSAL 3	PROPOSAL 4	PROPOSAL 5	PROPOSAL 6 2/
Transp. Rate Savings	92,012	141,883	146,165	162,431	175,022	188,986
Winter Rate Savings	7,350	7,359	7,397	7,405	7,405	7,405
Stockpile Savings	11,996	13,075	21,493	22,695	23,239	23,757
TOTAL	111,358	162,317	175,055	192,531	205,666	220,148
Avg Annual Costs						
Total Investment Cost	239,693	271,182	424,925	431,084	450,969	500,761
Annual Costs:						
Interest & Amortization	17,643	19,960	31,277	31,730	33,194	36,859
Operations & Maintenance	10,317	11,289	17,146	17,840	18,867	19,788
TOTAL	27,960	31,249	48,423	49,570	52,061	56,647
Benefit/Cost Ratio	4.0	5.2	3.6	3.9	4.0	3.9
Net Benefits						
Ben-Costs	83,398	131,068	126,632	142,961	153,605	163,501

1/ Definition of Proposals:

Extended Season Proposals	Estimated Starting Date of Vessel Operations	Lake Superior St. Marys River Lake Michigan Straits of Mackinac Lake Huron	St. Clair River Lake St. Clair Detroit River Lake Erie	Welland Canal Lake Ontario St. Lawrence River
Base Condition	Prior to 1987	1 Apr - 31 Jan	1 Apr - 31 Jan	1 Apr - 15 Dec
1	1987	Year-round	1 Apr - 31 Jan	1 Apr - 15 Dec
2	1990	Year-round	1 Apr - 31 Jan	1 Apr - 31 Dec
3	1990	Year-round	Year-round	1 Apr - 31 Dec
4	1992	Year-round	Year-round	20 Mar - 31 Dec
5	1995	Year-round	Year-round	7 Mar - 7 Jan
6	2000	Year-round	Year-round	7 Feb - 7 Jan

Thirdly, users of bulk commodities such as iron ore and coal, which are transported on the Great Lakes during the 1 April to 15 December navigation season, stockpile resources for winter production needs in addition to contingency needs. Stockpiling savings which would result from a reliable winter supply include interest on capital invested in the stockpile inventory itself and reduction of handling costs incurred in stockpile management.

Summary - Benefits/Costs of Navigation Season Extension

The benefits and costs, described above, and the resulting benefit/cost ratio, for each of the six proposals for navigation season extension on the entire system is shown in Table 2. Also displayed are the net benefits associated with each of the six proposals. The net benefit is the difference between benefits and costs for each particular proposal.

Environmental Considerations

Environmental considerations include known impacts on the environment, and those impacts which may become potential concerns. Because the winter navigation program is the first of its type in the United States, there is a lack of baseline information concerning biological conditions in the Great Lakes/St. Lawrence Seaway System during the winter months. Biological information was collected during the Demonstration Program; however, it was generally site specific, and investigations fell short of answering all the questions concerning impacts and system-wide environmental feasibility. This circumstance led to the Programmatic EIS and Adaptive Method, previously discussed.

Environmental effects of the recommended plan were considered to be minimal in the analysis and evaluation of alternatives considered in the March 1976 Interim Feasibility Report, which recommends navigation season

extension to 31 January (± 2 weeks) on only the upper four Great Lakes using fundamentally existing operational measures. However, in response to agency concerns expressed by the Environmental Protection Agency and the U.S. Fish and Wildlife Service, a three-year environmental appraisal program (conducted concurrently with vessel operation during the first three years of operation) was also recommended by the Chief of Engineers in his 16 November 1977 report to validate present environmental assessments through additional data collection, monitoring and evaluation. The Chief of Engineers Report also includes the provision of shore erosion and shore protection measures for the St. Marys River and St. Clair River-Lake St. Clair-Detroit River system which would be implemented as a result of damages caused by extended season operations to 31 January (± 2 weeks) on the upper four Great Lakes.

Since 1976 additional environmental analyses have been conducted relating to air quality, noise, energy, sediment transport and shore erosion, benthic communities, vegetation, fisheries habitat, and wildlife resources. Based on the analyses conducted to date, no significant overriding environmental impacts have been identified which would preclude proceeding with an extended navigation season beyond 31 January (± 2 weeks) on the upper four Great Lakes. However, the state-of-the-art, with available biological information, data, and ecosystem understanding, is not able to provide the total confidence in impact predictions desired at this time. Consideration of the environment in the form of the Adaptive Method (including Phase Implementation) evolved from three basic choices: (1) fully determine environmental feasibility prior to authorization; (2) preliminarily determine environmental feasibility prior to authorization, but conduct comprehensive studies on critical areas following authorization (but before construction or operation); and (3) preliminarily determine environmental feasibility prior to authorization, conduct any environmental studies on an "as needed" basis during construction or operation. The first possibility has been endorsed by several interest groups and the State of New York. While the alternative itself is the most

environmentally conservative, the cost to conduct such studies before determining the exact authorized project bounds is prohibitive. The third possibility, the most environmentally liberal, leaves the environment vulnerable to irreversible losses. The second possibility synthesizes the advantages of the other two -prohibiting a commitment of the environment before the ramifications may be fully discerned, at a reasonable cost.

Studies necessary for this approach are more specifically defined in the Environmental Plan of Action (Appendix E), which could be implemented, in concert with the phased implementation of the six proposals of season extension, during the first 10 to 15 years of the authorized project. The environmental data obtained would be used to refine the activities currently being recommended during the advanced engineering and design phase prior to construction and implementation. If any impacts were found to be significant, provisions would be made for any necessary mitigative or corrective actions, including the halting of vessel traffic if warranted.

RATIONALE FOR RECOMMENDED PLAN

The previous section on plan development discussed the identification of a National Economic Development (NED) plan and an Environmental Quality (EQ Oriented) plan. The NED plan, while maximizing net economic benefits in order to achieve a permanent extension of the navigation season, would not fully satisfy all the planning objectives as set forth for this project study. This is due to the fact that the NED plan would not include a comprehensive Environmental Plan of Action which provides for an ADAPTIVE METHOD approach for determining environmental feasibility of an extended navigation season program and is aimed at enhancing environmental quality wherever possible. The EQ (Oriented) Plan as described in this report would provide the mechanism to collect sufficient baseline data, evaluate, assess, and address the impact of proposed actions, and monitor and validate on-going actions. This approach would insure the environmental compatibility of the plan of improvement and possibly result in a net

enhancement of environmental quality when viewing the system as a whole. A net positive contribution to the environmental quality account would provide for the eventual implementation of a true EQ project plan. The addition of the Environmental Plan of Action and the resulting ADAPTIVE METHOD approach to the basic NED plan should not unacceptably reduce the economic effectiveness of the selected plan. It would also be in much closer conformity to fulfilling all the study planning objectives. As such, it is being recommended that the EQ (Oriented) Plan, as currently described in this report, be selected over the NED plan.

As stated in previous paragraphs, six proposals were developed to further extend the navigation season on the entire Great Lakes/St. Lawrence Seaway System beyond 31 January (± 2 weeks) on the upper four Great Lakes, each to be implemented in sequence called phased implementation. The last step of the proposed phased implementation is Proposal 6 (see Table 1) - extending the navigation season from 10 to 11 months on Lake Ontario and the International Section of the St. Lawrence River, 12 months on the upper three Great Lakes, and up to 12 months on Lake Erie.

Proposal 5 appears to be the best plan of improvement, and it suggests that the navigation season be extended up to 10 months on Lake Ontario and the International Section of the St. Lawrence River, 12 months on the upper three Great Lakes, and up to 12 months on the St. Clair River-Lake St.Clair-Detroit River System and Lake Erie (Proposal 5). This recommendation is being made with the realization that the ice forming period in the International reach of the St. Lawrence River (above Massena, New York) may not coincide with that in the all Canadian reach below Cornwall, Ontario. As a result, in a given year, the closing date for navigation on the St. Lawrence River may have to be shifted somewhat to accommodate ice formation in these two reaches under Proposal 5.

Proposal 6 has the following shortcomings:

(1) Uncertainties as to the impacts on water levels and flows during the 11-month in this portion of the system, due to ice control structures and/or dredging.

(2) Eleven-month navigation is currently beyond any plans to extend the navigation season being considered by the Canadian Government.

(3) The question as to the need for major dredging on the St. Lawrence River, to extend the navigation season on the St. Lawrence River to 11 months, has not been completely resolved (i.e., engineering feasibility has not been determined). In addition, significant objection has been raised by the U.S. Fish and Wildlife Service, State of New York, and local residents to the potential impacts of any major dredging to enable 11 month navigation on this portion of the system.

(4) Should dredging be considered necessary, the economic incremental justification as to maximization of net project benefits is still somewhat speculative due to the uncertainty as to the type and extent of dredging required. As can be seen on Table 2, an extension of the navigation season from 10 months to 11 months on Lake Ontario and the International Section of the St. Lawrence River may or may not be incrementally justified based on the current preliminary minimum and maximum quantity estimates of possible dredging that may be used.

(5) A 10-month season allows for more deliberate lock maintenance.

(6) An eventual 10-month season may tend to strike a balance between environmental and economic interests.

Because of its seeming importance on the St. Lawrence River, several factors must be considered relating to the necessity for dredging, and the magnitude of dredging required, to provide for extended season navigation, particularly in the reach between Chimney Point (Ogdensburg, NY) and the downstream end of Ogden Island.

A primary concern is the maintenance of a stable ice field. If this is not accomplished, loose ice could contribute to the formation of ice jams. This would increase ice retardation, defined as the reduction of the flow of a river due to ice cover. Ice retardation can also be accentuated by increased ice roughness and/or thickness.

The formation of ice jams and increased ice retardation could result in: (a) impeding commercial navigation; (b) a decrease in water levels below Low Water Datum downstream of the ice jam; (c) reduction in the flow to the extent that reductions in hydroelectric power generation result; and (d) possible upstream flooding.

There are several options that can be evaluated in overcoming these difficulties. The alternatives include:

(1) Reducing the regulated outflow of the St. Lawrence River coupled with the necessary regulation changes in the downstream (Canadian only) portion of the river;

(2) Dredging, for the purpose of reducing flow velocities to promote a stable ice cover and installation of additional ice control structures and the temporary control or cessation of vessel movement to allow for the initial development of a stable ice cover; and,

(3) Annual installation of ice control structures combined with the cessation of vessel traffic during the ice formation period, without dredging.

Solutions must incorporate allowances for the development and maintenance of a stable ice cover. In the St. Lawrence River reach between Chimney Point and the downstream end of Ogden Island, the existing average

river flow velocities range from 1.0 fps to 3.5 fps at a river flow of 220,000 cubic feet per second (the flow during the ice formation period). Ice booms would be installed in this reach to control the movement of ice, to promote a smoother, thinner ice cover and thus increase the flow capacity of the river. However, due to the existing velocities in this reach, utilizing a series of ice control structures, independent of other improvements, may not provide satisfactory results for an 11-month navigation season.

The reduction in regulated outflows alternative primarily addresses increased draft needed upstream of the control structures to accommodate navigation. If this alternative were implemented, it would involve the redistribution, over time, of water available for hydroelectric power and would require additional dredging for maintenance of vessel draft in Canadian waters. Since Canadian co-participation has not been agreed to, so far in this study, the alternative cannot be fully evaluated at this time. This alternative could be addressed during the advanced engineering and design phase, which would include Canadian co-participation.

The annual installation of a series of ice control structures in the International Rapids reach in combination with a cessation of vessel traffic during the ice formation period (early January to early February) should provide a satisfactory solution to the problem of 10-month extended navigation in this reach. To assure the proposed control structures would function as intended, a combination of mathematical and physical models would be developed and constructed. This would be coupled with a vessel transit test of the system of structures during the advanced engineering and design phase of project implementation.

Due to the velocities which currently exist in this reach, a series of ice control structures, alone, may not provide satisfactory results for an 11-month navigation season. Therefore, for an 11-month navigation season, it may be necessary to dredge approximately 25.2 million cubic yards of

material from various portions of this reach in order to reduce the average river flow velocity to 2.25 fps. This reduced velocity, in conjunction with ice control structures, would, given proper weather conditions, allow a greater opportunity for a stable ice cover to develop and remain during ship passage.

EVALUATED ACCOMPLISHMENTS

Accomplishments resulting from Proposal 5 would encompass:

a. Direct economic benefits would be received from the project. Total average annual benefits (at 7-1/8 percent) including transportation savings, vessel utilization savings and stockpiling savings, would be for the 50-year project life. Average annual costs would be with a resultant benefit-cost ratio of 4.0.

b. More efficient and better utilization of existing facilities would occur such as harbor and terminal facilities and services, channels and waterways.

c. Certain potential beneficial social impacts would be realized as a result of the study plan. The growth of the region would accelerate and as a result would cause increases in overall regional property values; increases in revenues to states, counties, and communities; increases in employment; and increased use of business, harbor, and industrial facilities. Installation of ice control structures on the St. Marys, St. Clair, Detroit, and St. Lawrence Rivers would stabilize ice cover on these channels, which in turn would tend to reduce any impacts on shoreline uses and minimizes damage to shore properties. Also, ice jams in constricted areas would be reduced, lessening potential for flooding such as on the St. Clair River, and would enable a more uniform water flow which in turn would benefit power production such as on the St. Marys and St. Lawrence Rivers.

Navigation during the winter season is not legally prohibited on the Lakes-Seaway system. However, improvements to the system such as navigation aids, etc., may not be installed for winter operations without Federal approval. With a Federally supported program, navigation aids, ice and weather collection and forecast questions, and ice control and management measures would enhance the safety of operations and subsequently reduce the overall element of risk. This would have a direct effect on vessel crews.

d. The Environmental Plan of Action, to be implemented concurrently with the phased implementation of an authorized extended season program, is being designed to provide assurance that winter navigaiton will be conducted in an environmentally acceptable manner, with provisions made for accomplishing any necessary mitigative acitons, and possibly result in an overall enhancement of environmental quality for the system. The plan consists of comprehensive system-wide environmental baseline data collection, impact evaluation project modification if required, and monitoring during operation to provide this assurance. Appendix E presents the EPOA.

e. The recommended plan would tend to provide parity in the competitive posture of the Great Lakes as related to other National and International seacoasts. It could also enhance the international competitive posture of key national industries.

IMPACT ASSESSMENT FOR RECOMMENDED PLAN

Economic Justification - Recommended Plan

It is necessary to subtract out the benefits contained in the March 1976 Interim Feasibility Report to extend the navigation season to 31 January on the upper four Great Lakes from the total benefits associated with the recommended plan in order to accurately determine the economic

TABLE 3

TOTAL ANNUAL U.S. BENEFITS FROM RECOMMENDED PLAN (PROPOSAL 5) TO EXTEND NAVIGATION SEASON
(In $1,000 at 7-1/8%, and in 1,000 Tons)

Tonnage Benefited	1987	1990 1/	1992	1995 2/	2000	2040	Average Annual Benefits
Tons Div. Fr. Alt. Mode	4,721	8,546	10,554	16,209	27,173	47,164	24,248
Tons Ben. by Winter Rates	67,476	177,104	182,350	185,902	188,399	214,185	186,944
Tons Saved from Stockpile, Lock	4,126	10,524	20,647	21,706	21,735	22,179	18,726
Tons Saved from Stockpile, Non-Lock	1,010	1,540	3,009	3,201	3,521	7,085	3,307
Benefits							
Transp. Rate Savings	14,174	66,398	93,832	132,452	183,958	333,296	175,022
Winter Rate Savings	5,400	5,947	6,271	6,656	7,392	10,642	7,405
Stockpiling Savings	5,174	12,634	24,859	26,356	26,719	30,864	23,239
Total Benefits	24,748	84,979	124,962	165,464	218,069	374,802	205,666 3/

1/ 1990 is the estimated start of year-round navigation on all of the upper four Great Lakes.

2/ Estimated start of 10-month navigation on the St. Lawrence River.

3/ This average annual benefit figure does not include the following savings which could be realized under the 31 January ± 2 weeks plan contained in the March 1976 Interim Report:

Winter Rate Savings	$ 4,982
Stockpiling Savings	5,471
Total	$10,453

Also, $27.4 million of transportation rate savings resulting from the operational plan recommended in the March 1976 report are not tabulated as part of subsequent season extension proposals.

feasibility of the recommended plan. The recommended plan is to extend the navigation season 12 months on the upper three Great Lakes, up to 12 months on the St. Clair River-Lake St. Clair-Detroit River System and up to 10 months on the Lake Ontario and the International Section of the St. Lawrence River. This prevents double-counting of benefits and assures that only those incremental benefits that are in excess of those contained in the March 1976 Interim Feasibility Report are allocated to the recommended plan. The above average annual benefits associated with the March 1976 Interim Feasibility Report were subtracted out from the total benefits of each of the six proposals to extend the navigation season.

Table 3 presents a breakdown of the total average annual benefits for the recommended plan to extend the navigation season.

Table 4 summarizes those requirements and costs associated with the recommended plan to extend the navigation season throughout the system. The detailed requirements and costs of the recommended plan are presented in Appendix B.

Harbors Included in Recommended Plan

In the Great Lakes/St. Lawrence Seaway economic region, cargo flows to and from Bureau of Economic Analysis (BEA) areas located in the 19 States of this region. For origin or destination from BEA's away from the lakes, no indication is given as to what lakeside BEA or port the cargo is shipped through, therefore, this traffic has been allocated to the nearest lakeside BEA. Traffic that has an origin or destination within a lakeside BEA usually moves through a port or ports within that BEA. However, BEA's frequently contain more than one port which raises a question on how to allocate traffic among these ports.

To overcome the difficulty as to what ports the commodities flow through, a port/split methodology was developed. A detailed description of

TABLE 4

TOTAL ANNUAL COSTS OF
RECOMMENDED PLAN TO EXTEND NAVIGATION SEASON
(IN $1,000 at 7-1/8%)

Harbor Subtotals	
Total Investment	$ 33,938
Annual Interest & Amortization	2,498
Annual Operations & Maintenance	6,189
TOTAL ANNUAL COST	$ 8,687
Channels & Lakes Subtotals	
Total Investment	$ 417,031
Annual Interest & Amortization	30,696
Annual Operations & Maintenance	12,678
TOTAL ANNUAL COST	$ 43,374
Grand Totals	
Total Investment	$ 450,969,000
Annual Interest & Amortization	33,194,000
Annual Operations & Maintenance	18,867,000
TOTAL ANNUAL COST	$ 52,061,000

NOTE: The current benefits to cost ratio does include social costs, such as shore structure protection and island transportation, but does not reflect all anticipated environmental disbenefits (costs) due to their unquantifiable nature. Some environmental costs, such as shore protection, are included, however. The benefit/cost ratio also includes the estimated cost for completing the Environmental Plan of Action (EPOA). For those environmental disbenefits which can be quantified, the dollar cost would be included in the B/C ratio. These revised B/C ratios would be reviewed at each stage of post authorization, planning, and design, to insure that no economically unfeasible plans are constructed.

TABLE 5

AVERAGE ANNUAL BENEFITS AND COSTS
FOR U.S. HARBORS IN RECOMMENDED PLAN
(in $1,000 at 7-1/8%)

	Harbor Annual Benefits	Harbor Annual Costs	Benefit/Cost Ratio
Two Harbors, MN	$ 5,488	$ 1,678	3.3
Duluth-Superior, MN-WI	52,426	14,263	3.7
Presque Isle, MI	1,703	516	3.3
Marquette, MI	159	192	0.8
Taconite, MN	5,640	1,723	3.3
Silver Bay, MN	5,623	1,744	3.2
Ashland, WI	250	668	0.4
Green Bay, WI	478	373	1.3
Milwaukee, WI	2,997	323	9.3
Calumet Hrbr., IN-IL	13,917	1,841	7.6
Indiana Harbor, IN	6,888	1,200	5.7
Burns Waterway, IN	1,925	461	4.2
Gary, IN	3,888	689	5.6
Escanaba, MI	2,822	1,571	1.8
Ludington, MI	6	401	0.0
Port Washington, WI	426	131	3.3
Saginaw, MI	10	539	0.0
St. Clair River, MI	1,562	477	3.3
Detroit, MI	25,641	3,425	7.5
Alpena, MI	44	290	0.2
Toledo, OH	9,002	2,011	4.5
Sandusky, OH	1,124	729	1.5
Huron, OH	3,826	1,407	2.7
Lorain, OH	5,198	1,791	2.9
Cleveland, OH	23,362	3,893	6.0
Ashtabula, OH	3,959	1,478	2.7
Conneaut, OH	6,763	2,274	3.0
Buffalo, NY	19,025	4,850	3.9
Monroe, MI	1,451	717	2.0
Muskegon, MI	66	405	0.2
TOTAL SYSTEM BENEFITS	$205,666	$52,061	4.0

this port/split methodology is contained in Appendix D. This port/split methodology was utilized to derive normal season and extended season traffic projections for those major Great Lakes harbors expected to benefit from the recommended plan.

A summary of the total estimated stockpiling, transportation rate, and winter rate benefits; the annual costs; and the ratio of benefits to costs for each of the major Great Lakes harbors having traffic benefiting from the recommended plan to extend the navigation season, are shown in Table 5. Only those benefits are displayed in Table 3 which are in excess of those benefits associated with the March 1976 Interim Feasibility Report.

In order to determine what percent of system costs (improvements that are not in a specific harbor, but are on the Great Lakes, the St. Lawrence River, or the connecting channels and locks) should be allocated to each of the major harbors, the total annual benefits accruing to each harbor were examined to determine whether they originated from season extension on the upper four Lakes alone or from extension on the entire GL/SLS System. A harbor should only share in the cost allocation for those system improvements from which it benefits. For example, if a harbor does not benefit from season extension on the St. Lawrence River, then the cost of the system improvements on the St. Lawrence River should not be allocated to it. The annual system costs allocated to harbors were added to the annual costs of improvements in the individual harbors themselves to derive total annual harbor costs for the recommended plan.

Only those harbors with a benefit/cost ratio of greater than 1.0 are economically justified. The following paragraph depicts what the impact on the overall benefit/cost ratio of the recommended plan would be if these economically unjustifiable harbors were excluded.

Benefit/Cost Ratio of Recommended Plan - Excluding Harbors Unjustified From a Federal Investment Viewpoint

If only those 24 harbors with a benefit/cost ratio greater than 1.0 (as shown in Table 5) are included in the recommended plan, then the overall annual benefits of the plan decrease from $205,666,000 to $205,131,000, and the overall annual costs decrease from $52,061,000 to $49,566,000. Therefore, the net effect on the benefit/cost ratio of the plan from the exclusion of these harbors is to increase the B/C ratio from 4.0 to 4.1. It should be noted that the decrease in benefits that results from the exclusion of these economically unjustified harbors stems from two factors: (a) the elimination of the benefits accruing to the economically unjustified harbors themselves, and (b) the elimination of the benefits accruing to those harbors that trade with the economically unjustified harbors. It is also important to note that the reapportionment of annual benefits and costs to the 24 remaining harbors does not result in any additional harbors becoming economically unjustified.

Possible Negative Benefits

Concerns expressed regarding possible negative benefits of season extension on (1) the environment (such as changes in fish and wildlife habitat/population and aesthetic values) and on (2) winter recreational use of lakes, harbors, and channels have not yet been fully quantified. They are not included in the current benefit/cost ratio of the recommended plan. The benefit/cost ratio does include the estimated amount for the Environmental Plan of Action (EPOA) and a winter recreation study, both of which are to initiated in the advanced engineering and design phase. Implementation of these studies would provide information as to the quantification of any environmental/recreational disbenefits associated with the recommended program. To date, no disbenefits attributable to the above items have been identified which would substantially alter the benefit/cost ratio. However, if environmental/recreational disbenefits become quantified during the advanced engineering and design phase, the

dollar amount will be included in the benefit/cost ratio during the post-authorization stage.

Some disbenefit is attributable to the proposed additional lockages of two of the U.S. locks at Sault Ste. Marie which could reduce the water available for power during the winter navigation season by less than 10 cfs. Based on the minimal cost of the power loss there would be no substantial impact on the benefit to cost ratio; therefore it is not included.

The comprehensive ice control system suggested for the St. Lawrence River should improve river conveyance and thus be a benefit to power. However, in order to be conservative costs associated with the worst possible impacts on power will be considered in the cost calculation.

Secondary Regional Impacts

Appendix D contains the results of the Regional Economic Benefits Study conducted for the Corps of Engineers by Booz, Allen, and Hamilton, to determine the regional impact of navigation season extension on the Great Lakes Region. This study depicts the regional benefits and employment accruing directly to individual Great Lakes ports, as well as the regional economies surrounding these ports. It is essential to note that these regional benefits only represent regional transfers of income to the Great Lakes Region from other regions of the country, based on that traffic which would be diverted to the GL/SLS from other transportation modes as a result of season extension. As such, these regional benefits are not included in the recommended plan's overall benefit/cost ratio, which addresses only net increases in the Nation's overall efficiency in the transportation of goods (as reflected in the project's primary, transportation-related benefits).

Table 6 summarizes the results of the Regional Economic Benefits Study by showing the regional benefits and additional ports jobs that would accure to the entire Great Lakes Region as a result of the recommended plan

TABLE 6

U.S. REGIONAL BENEFITS AND PORT JOBS ADDED IN THE GREAT LAKES REGION FROM THE RECOMMENDED PLAN ($1,000 AND NUMBER OF PORT JOBS)

CATEGORY	1987	1990	1995	2000	2020	2040
Regional Benefits	$126,979	$248,091	$370,290	$418,145	$508,993	$514,655
Port Jobs	1,804	3,262	4,328	4,391*	3,107*	1,751*

* After 2000, benefits increase at a very slow rate because the GL/SLS system is near capacity. Earnings per new employee escalate further than benefits; therefore, additional employment decreases.

to extend the navigation season. (Note: port jobs added include longshoremen, stevedores, terminal operators, merchant seamen, ship and equipment company personnel, and pilot and port administrators.)

Regional Disbenefits to Alternative Transport Modes

As mentioned above, navigation season extension will tend to divert future expected traffic away from the rail and trucking industries and Eastern and Gulf ports toward the GL/SLS System. This diverted tonnage is shown in Table 3. In order to determine what impact this diverted tonnage would have on the various transport modes and regions concerned, an Intermodal Impact Study was undertaken for the Corps of Engineers by TERA, Inc., and is described in Appendix D.

Based on the Intermodal Impact Study, the railroads show the largest impacts resulting from season extension of all the alternative modes. For coal and iron ore, the railroad is the only significant competing or supporting mode. Therefore, the only shifts that occur are from longhaul competing railroads to shorthaul supporting railroads. This results in a revenue loss to the railroads as a whole, although to the extent that different firms are impacted, some railroad companies who handle shorthaul supporting traffic may gain revenue. The most significant shift is in iron ore where Great Lakes vessels have traditionally carried the largest share of the cargo. Thus, any cargo not carried on the Great Lakes due to winter closing could be shifted from the railroads if the season is extended. Overland movements of grain shift not only from longhaul to shorthaul railroads, but between modes, resulting in a net loss of tonnage to the railroads. The impacts of season extension on railroads and the other alternate modes of transportation are discussed in more detail in Appendix D.

Again, it should be noted that any regional disbenefits would represent a regional transfer of income away from other transport modes and regions of the country to the Great Lakes Region and, as such, would not be

included in the recommended plan's overall benefit/cost ratio. This method for evaluation of regional dis-benefits is in accordance with 49 U.S.C. 1651 nt.

Energy Impacts

Appendix D contains the results of the Energy Impact Study undertaken for the Corps of Engineers by TERA, Inc., to determine the effect that navigation season extension would have on energy consumption. Specifically, this study compared the energy consumption associated with winter waterborne movement of bulk and general cargo during an extended navigation season to the energy consumption associated with winter movement of the same commodities via the least-cost alternative transport mode (rail, truck, barge). Energy impact results were based on severe winter conditions. Included in the analysis were the increased transit times and delays that would be associated with winter navigation operation for the various size vessels in the Great Lakes and overseas fleets, as well as the energy expended by the facilities and operations (the infrastructure) required to support winter navigation. The study concludes that there would be a small, but positive, energy impact associated with the increased GL/SLS waterborne movement that would result from an extended navigation season.

Table 7 summarizes the results of the Energy Study. As can be evidenced from this table, the study concludes that there would be a small, but positive, energy impact associated with the increased GL/SLS waterborne movement that would result from an extended navigation season. More importantly, it is felt that the conservative assumptions taken throughout this study (e.g., GL/SLS energy consumption was based on severe winter conditions; also, for the alternate route, the nearest or least circuitous ocean port was selected for transshipment overseas) assure that the conclusion cannot be reversed by any reasonable change in the assumptions underlying the analysis.

TABLE 7

SUMMARY OF NAVIGATION SEASON EXTENSION ENERGY IMPACTS
(BILLIONS OF BUT'S PER YEAR)*

ENERGY IMPACT AREA	1990	2000	2010	2020	2030
Normal Season Line Haul					
GL/SLS	58,753	64,416	67,677	70,350	72,795
Alt. Transport Mode	500,851	748,822	1,062,939	1,409,263	1,772,418
Total Norm. Seas. Line Haul	559,604	813,238	1,130,616	1,479,613	1,845,213
Extended Season Line Haul					
GL/SLS	59,936	72,623	87,880	90,986	93,934
Alt. Transport Mode	498,955	739,705	1,041,522	1,387,092	1,749,313
Total Ext. Seas. Line Haul	558,891	812,328	1,129,402	1,478,078	1,843,247
Net Line Haul Savings	713	910	1,214	1,535	1,966
Less Infrastructure Energy Use:					
Ice Breakers	373	459	459	459	459
Ice Reconnaissance	21	21	21	21	21
Bubblers	59	59	59	59	59
Local Tugs	8	34	80	78	79
Tugs at Locks	99	99	99	99	99
Semi-Permanent Ice Controls	38	38	38	38	38
Other Associated Impacts	52	52	52	52	52
Total Infrastructure Costs	650	762	808	806	807
Net Energy Savings	63	148	406	729	1,159

*The energy impacts displayed in this table cover Season Extension beyond the base condition assumed for this report. Possible energy savings to be gained by implementing the recommendation in the March 1976 Interim Report (31 January, ± 2 weeks on the upper four Great Lakes) are not contained in this analysis.

Power Production

As far as the impact of winter navigation on power production is concerned, the expected ice condition with the recommended plan of improvement in operation is expected to maintain normal water levels and flows, therefore, there would be no significant impact on power on the upper lakes. The ice control system proposed for the St. Lawrence River should eliminate the severe ice dam problem in that river and would provide a benefit to power through increased head and the maintenance of outflow capability.

Environmental

Areas of concern have been identified as having the potential to be negatively impacted by extended season activities. These concerns include possible effects on air quality, noise levels, water resources, water quality, soil erosion, benthic communities, vegetation, fisheries, wildlife, and aesthetic values. Concerns within each of these areas are considered briefly in the Impact Assessment section of Appendix B, and are discussed in detail in the Environmental Appendix, Appendix F. Many of these concerns would be subject to further study under the Environmental Plan of Action, which is contained in Appendix E.

The validity of any conclusions drawn from the potential studies would be limited to the extent that any information gathered and analyzed would be representative of the interaction of an extension of the navigation season and the environment. The Environmental Plan of Action (EPOA) and subsequent 10/15 year monitoring and evaluation period would ultimately allow determination of the total environmental feasibility of a phased extension of the navigation season on the Great Lakes-St. Lawrence Seaway System to as much year-round. In addition, the environmental baseline data that is collected may be useful for other system-wide studies other than winter navigation.

In describing the development of the EPOA, definitions, criteria, and analysis rationale are set forth in the environmental statement, Appendix E, Environmental Plan of Action, and Appendix F, Environmental.

Social Well-Being

Concerns have been expressed by correspondence and at public meetings regarding: potential damages to the shoreline and shore structures due to vessels operating in constricted areas of connecting channels and ice; potential hazards to public safety, health, and welfare of crew members and personnel required to cross channels on ferry boats; the potential disruption of outdoor recreation activities such as ice fishing and snowmobiling; other potential adverse environmental impact on vessel crews such as the ship-induced noise and vibrations of ships; and potential disruption of power generating facilities due to ice jams. To insure that all social effects of navigation season extension are identified, the Winter Navigation Board created the Social Effects Group to review all previously identified social effects and to identify a range of potential future effects. The Group concluded that social effects were identified in four major categories which were considered in the development of Appendix H: recreation, shore erosion and structure damage, cross channel transportation, and occupational groups.

Recreation studies completed to date do not fully assess the present or potential economic impacts of season extension activities on winter recreational activities. The implementation of winter recreation studies to identify those water-based recreation activities impacted by specific winter navigation activities has been considered in the Environmental Plan of Action and proposals for additional recreational studies are also considered as discussed in Appendix H, Social Aspects of a Winter Navigation Program. These studies would more fully isolate the complete social and economic impacts and suggest specific long-term solutions to alleviate or lessen any impacts.

Shore erosion and shore structure damage along and in the vicinity of parts of the connecting channels is considered by the public to be at least partially caused by the winter navigation activities. Studies on this subject substantiate this allegation, at least in part.

Courses of Action have been formulated to ascertain ways of providing riparian owners with relief from shore erosion and shore structure damage associcated with the Great Lakes-St. Lawrence Seaway Navigation Season Extension Program. These courses of action range from the Government's current exercise of its navigable servitude of all land and structures below the ordinary high water mark in navigable waters (in which responsibility on the part of the Government is absent) to that of accepting full and complete responsibility for financing the repair and replacement of all structural damage and erosion. In addition, there are several intermediate, responsibility-sharing alternatives. It should be realized during this discussion that, according to the doctrine of navigable servitude over all lands and structures below the ordinary high water mark in navigable waters, the Federal Government can normally only be held responsible for structural damage or loss of property occurring above this mark. Consequently, unless some new enabling legislation takes place, the Government would not be liable for any damage resulting to property below the ordinary high water mark. and, therefore, cannot compensate the owner. For further discussion of "Federal Navigation Servitude," see Appendix L, LEGAL CONSIDERATIONS.

Six alternative courses of action may be grouped as possible solutions which are compensatory in nature. These compensatory actions will require Congressional authorization. The two extreme positions on this spectrum have already been indicated. Two of the intermediate positions involve the Government providing financial support on a one-time basis to repair, replace, and/or compensate for losses below the high water mark. One alternative would compensate for erosion losses only; the other would include structural damage as well. Subsequently, both present owners and future buyers would be put on notice that expense of repair for further

structural damage or erosion would be borne by the individual without Governmental assistance.

Another compensatory-type alternative would be the provision of tax incentives for riparian land owners, to encourage efforts on their parts to protect shorelines and shore structures. A tax incentive scheme would spread these shorelines costs of a Winter Navigation Program among all citizens. This would be in line with the benefits of the Program, which would be expected to spread thoughout the national economy. Tax credits or deductions could be limited only to the protection of existing structures as a means of reducing costs, with all new structures the responsibility of the owners themselves.

A Federal Insurance Program for the shoreline areas affected by Winter Navigation could be sponsored by the Government as another alternative in offering riparian residents some protection. This could run along lines similar to the Government's Flood Insurance Program.

These compensatory-type alternative courses of action would not automatically be considered mutually exclusive. Different elements of a one-time government compensation program, the provision of tax incentives, and the offering of an insurance program could be combined in various ways to deal with the problem of compensating for shore erosion.

In addition to these types of measures, preventative-type actions could also be taken to reduce the possibility of shoreline damage. On long areas of shoreline especially sensitive to erosion, structural actions could be taken by the Corps of Engineers, the type of structure depending on site specific characteristics. Other preventive-type alternatives aimed at reducing the disruption of ice cover could include these non-structural options: (1) vessel speed regulation, or more stringent enforcement of current standards; (2) regulating vessel movement through unstable ice fields, or even halting traffic during critical ice breakup periods, and (3) vessel route regulation, avoiding the breaking of multiple tracks

whenever possible. These preventative actions can be considered at any time, regardless of decisions taken involving the first six compensatory-type courses of actions. All the alternatives are discussed in greater detail in Appendix B, within the Social Well-Being section.

Selecting among these alternative courses of action would appear to require a balancing, between the provision of compensation at a moderate scale, on the one hand, and satisfactorily meeting complaints by riparian owners of damages incurred as a result of a navigation season extension. The costs of a compensation scheme could be substantial, but they would depend in part on further determinations as to which shoreline areas are particularly sensitive to the effects of extended season operation.

The preventative measures that can be taken to reduce shore erosion are an important element in plans to minimize the negative effects of an extended navigation season. Federal protection of environmentally high-risk areas, vessel speed control, vessel route regulations, and the regulation of vessel movement through unstable ice fields are viable ways of sharing the responsibility for minimizing negative effects associated with shore erosion and shore structure damage.

The Government cannot immunize itself from liability for damages caused above the ordinary high water mark, and this situation would continue.

Cross channel transportation requirements have been reviewed in the St. Marys, St. Clair, Detroit, and St. Lawrence Rivers. Specific plans have been proposed in this report which would minimize the impact of winter navigation on island transportation, such as bubbler/flusher systems and ice control structures, as well as contingency plans for each one of the inhabited islands.

Social effects of winter navigation activities need to be monitored during the purposed validation period and be included in future assessment reports. During the advanced engineering development stage, implementation

of a demographically based monitoring study utilizing the "social well-being account" methodology is proposed. The study would monitor selected areas throughout the region and document the gross social effects of extended season operations on various types of communities and occupational groups. The results of the monitoring program would be a part of future environmental statements and validation reports.

Four occupational groups (vessel, terminal, lock, and pilot personnel) have been identified as being directly affected by winter navigation activities. In October 1976, a sociological assessment was done for the Department of Commercial, Maritime Administration, to identify the concerns those groups had regarding winter navigation. The major findings included the following: voluntary participation during the extended season, the effect on family life, and greater employer-employee communication about the winter shipping season. Recommendations regarding those concerns are contained in the survey document, (Great Lakes Sociological Assessment Survey, from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Publication No. 263180-AS.) which were considered in this survey study. This report is available to labor and industry groups affected by winter navigation for their consideration of possible action. Also, other solutions being considered in this final survey report -- and in some cases already implemented -- are the provision of cold weather gear for lock and terminal personnel, ice and snow removal, safety lines for line handlers, and contingency plans for rescue and revival. Solutions considered for pilot and vessel personnel are: a vessel monitoring and reporting system; emergency position indicating radio beacons; all-weather individual exposure suites, and float-out crew capsules.

Risk

Without full implementation of operational measures recommended, the risk of ice jamming and subsequent flooding would increase. Icebreaking assistance, improved aids to navigation, air bubbler systems along

constricted areas of navigation channels, ice control structures, and real time data collection and dissemination systems are examples of improvements which are designed to make operating in the system easier during the winter months and, in turn, would reduce the element of risk. Other risks, such as oil spills, crew safety, etc., are being analyzed and reduced through project improvements. Areas continually being addressed are shipment of hazardous substances, crew and vessel safety, and vessel operating capabilities. Long-term risk to the ecosystem is being comprehensively addressed in the previously mentioned Environmental Plan of Action.

In June 1972, the Great Lakes and St. Lawrence Seaway Study of Insurance Rates was prepared by the Maritime Administration, U.S. Department of Commerce, in accordance with Section 107(c) of P.L. 91-611. This study detailed the physical risks, risk management and insurance costs attendant to an extension of the navigation season. The study also examined the factors that inhibit an extension of the season together with methods of countering these factors and legislative recommendations to implement a government program to provide marine insurance. The results of the 1972 report were updated in June 1979. The conclusions of the update indicated that insurance rates do not inhibit season extension.

Levels and Flows

The Levels and Flows Appendix prepared for this report describes the hydraulic characteristics of the Great Lakes-St. Lawrence System with particular emphasis on ice formation, roughness and thickness and their effects on levels and flows. It includes a discussion of these conditions in relation to present conditions and the possible range of impacts that changes in these conditions (as a result of movement of vessels through the ice) may have on the levels of the Great Lakes and flows in the Connecting Channels and St. Lawrence River and is summarized below.

Description of the Problem

The levels of the Great Lakes reflect the total net supply of water to the lakes and that which flows out through their outlet channels. Since these channels are presently and naturally subject to blockage or retardation due to ice, anything which affects this natural process could, in turn, impact on the systems levels and flows. Since significant navigation historically ends by mid to late December, extension of the season could have an effect on this ice formation process. The extended season could cause the ice to be rougher and/or thicker, thereby increasing retardation, or measures may be introduced to prevent the formation of the cover, thereby reducing or eliminating ice retardation. In either case, the effect of the changes have been evaluated and mitigative measures proposed where impacts are identified.

Approach to Determining Impacts

The probable impacts on Lake Superior and its outlet river, the St. Marys, were determined from an examination of the Demonstration Program which has existed on that system since 1972.

To analyze the potential effect of movement of vessels through the ice fields in the connecting channels and the St. Lawrence River, it was hypothesized that the carrying capacities of these channels (under ice conditions) would either be improved or be further hindered due to changes in ice conditions. The historic ice retardation values for the St. Clair and Detroit Rivers were varied from total elimination of all ice effect (0 percent retardation) to that of doubling the effect of (200 percent or twice that now being experienced). The results of these variations in ice retardations were converted to impacts on levels and flows by routing these changes in water supply through the system for the 1960-1978 period. It should be noted that the numbers presented in this report are not to be considered as a prediction of possible impacts but show the extreme condition for a hypothetical range of assumed conditions.

Since the Niagara River is not used for navigation (interlake traffic uses the Welland Canal) no impacts on that river are expected. However, changes in flow and additional lockages due to season extension could impact on the level of Lake Erie and the regulation of Lake Ontario, as well as the amount of water available for power generation.

Since Lake Ontario is regulated, maximum probable impacts were determined for possible changes in ice thickness and roughness on the St. Lawrence.

Where possible impacts on levels and flows were identified remedial measures were developed.

Impacts and Mitigation Measures

Based upon the actual observed conditions on the St. Marys River and mathematical analyses during the Navigation Season Extension Demonstration Program, extension of the navigation season has been determined to have no appreciable impact on the levels and flows out of Lake Superior or the St. Marys River.

Theoretical impacts of eliminating all ice retardation on the St. Clair and Detroit Rivers could reduce the monthly mean level on Lake Michigan-Huron by as much as 3-1/2 inches in a given month and could increase the monthly mean level on Lake Erie by as much as 5 inches in a given month.

The theoretical impacts of doubling the ice retardation on the St. Clair and Detroit Rivers could increase the monthly mean water level on Lake Michigan-Huron by as much as 3-1/2 inches in a given month while reducing the monthly mean water level on Lake Erie by as much as 5-1/2 inches in a given month.

To restore the flows of the St. Clair and Detroit Rivers to what they would be, assuming total elimination of ice retardation, would require a

flow retarding structure be placed in each river. Should further detailed study show such structures to be necessary, it is suggested they be located at Stag Island in the St. Clair River and at Peach Island in the Detroit River. These structures are described in the Recommended Plan Description section of this report with costs identified in the Design and Cost section of this report.

Mitigation for the impacts of above normal ice retardation on the St. Clair and Detroit Rivers has not been identified because, if the extended navigation season becomes an actuality, it has been proposed that ice control structures be placed at the head of both rivers. These structures would reduce the natural ice retardation in these rivers and would therefore preclude the possibility of attaining above normal ice retardation.

The 10-month use of the Welland Canal could result in additional lockages occurring in the winter and could result in an ultimate lowering of Lake Erie by an amount substantially less than 0.10 foot. This impact could be offset with a reduction in the average monthly flow through the Welland Canal of approximately 100 cfs throughout the non-winter navigation season.

The ice control structures, necessary for 10 month navigation on the St. Lawrence River, could reduce changes in ice roughness and thickness in the St. Lawrence River as a result of winter navigation. Without these measures, navigation would not be possible. A sensitivity analysis, which tested the theoretical impacts of change in ice roughness and thickenss along the St. Lawrence River, showed that as the undercover of the St. Lawrence ice became rougher, the ability to flow water through the ice-covered channels is hampered and, therefore, the water level profile is lowered. The results also showed that increasing the uniform river ice thickness from 12 inches to 24 inches and holding the Lake Ontario water level and the St. Lawrence River flow constant, reduced the water level at Lake St. Lawrence by as much as 1.34 feet. On the other hand, it should be

noted that limited model test made in connection with the Demonstration Program indicated that winter navigation would not appreciably impact ice roughness.

The ice control structures could also reduce or eliminate the possibility of the occurrence of hanging ice dams in the St. Lawrence River. The elimination of the hanging dam constriction is necessary to allow for navigation in that river. An evaluation of the theoretical impacts of such a hanging ice dam occurrence without the proposed changes showed a reduction in the Lake St. Lawrence water level by as much as 2.45 feet below what it would be under normal river ice conditions.

Institutional

The detailed recommended plan presented at the conclusion of the planning process is to be capable of being implemented based on its institutional and technological feasibility. This section will discuss the structure and composition of a body to superintend and guide the planning, environmental investigations, design, construction, and possibly initial operation means, to extend the navigation season (to up to year-round) on the Great Lakes-St. Lawrence Seaway.

Background: The Winter Navigation Board has provided advice and guidance to the U.S. Army Corps of Engineers in the accomplishment of the survey study directed under Section 107(a) of the same Act. Since the Charter and reason for existence of the Board expires with the conclusion of the demonstration's authorizing legislation on 30 September 1979, a transition group, similar to the Winter Navigation Board, would be desirable to continue to provide advice and guidance to the Corps of Engineers in pursuit of its survey program. More importantly, if enabling legislation is passed to proceed (at full or a reduced scale) with a Season Extension Program, some body -- similar to the St. Lawrence River Joint Board of Engineers of Canada and United States which guided the construction in the 1950's of the St. Lawrence Seaway -- could be established to superintend

and guide the planning, environmental investigations, design, construction, and possibly initial operation of the extended season program on the Great Lakes-St. Lawrence Seaway.

Need. In summary, if enabling legislation is passed to provide the means to extend the navigation season on the Great Lakes-St. Lawrence Seaway, a superintending body would be required to plan, coordinate, and accomplish the effort. This body could and should be established in any such enabling legislation. Additionally, since the Charter of the current Winter Navigation Board runs out 30 September 1979, a transition group has been formed to coordinate winter navigation season closure determinations and potential agency management actions and to provide a forum for keeping the public informed of winter navigation activities. With its life span limited to one year, the Board will function as a team to resolve potential conflicts and to improve coordination of activities. It will not pre-empt the responsibilities established by law for any of its individual member agencies, nor will it infringe on the rights of any of the states bordering the upper Great Lakes.

Options. In looking at what options might be available to provide the superintendence and guidance of the season extension effort, one is quickly led to the success of the St. Lawrence River Joint Board of Engineers of Canada and United States, which superintended the construction of the St. Lawrence Seaway during the 1950's. The Joint Board consisted of four members, two U.S. and two Canadian. The two members for the United States were the Secretary of the Army (whose alternate was the Deputy Chief of Engineers) and the Chairman of the Federal Power Commission. This U.S. portion of the Joint Board, as was the Canadian, was also served by a Section on-site, headed by a civilian engineer and such staff of civil engineers, hydraulic engineers, foundation engineers, and administrative personnel, as appropriate. In reviewing functioning and workings of the St. Lawrence Joint Board, it became apparent that some its strengths were the relationship of its members to the needed interests at that time, the location of its members and alternate members within the Federal Capitals,

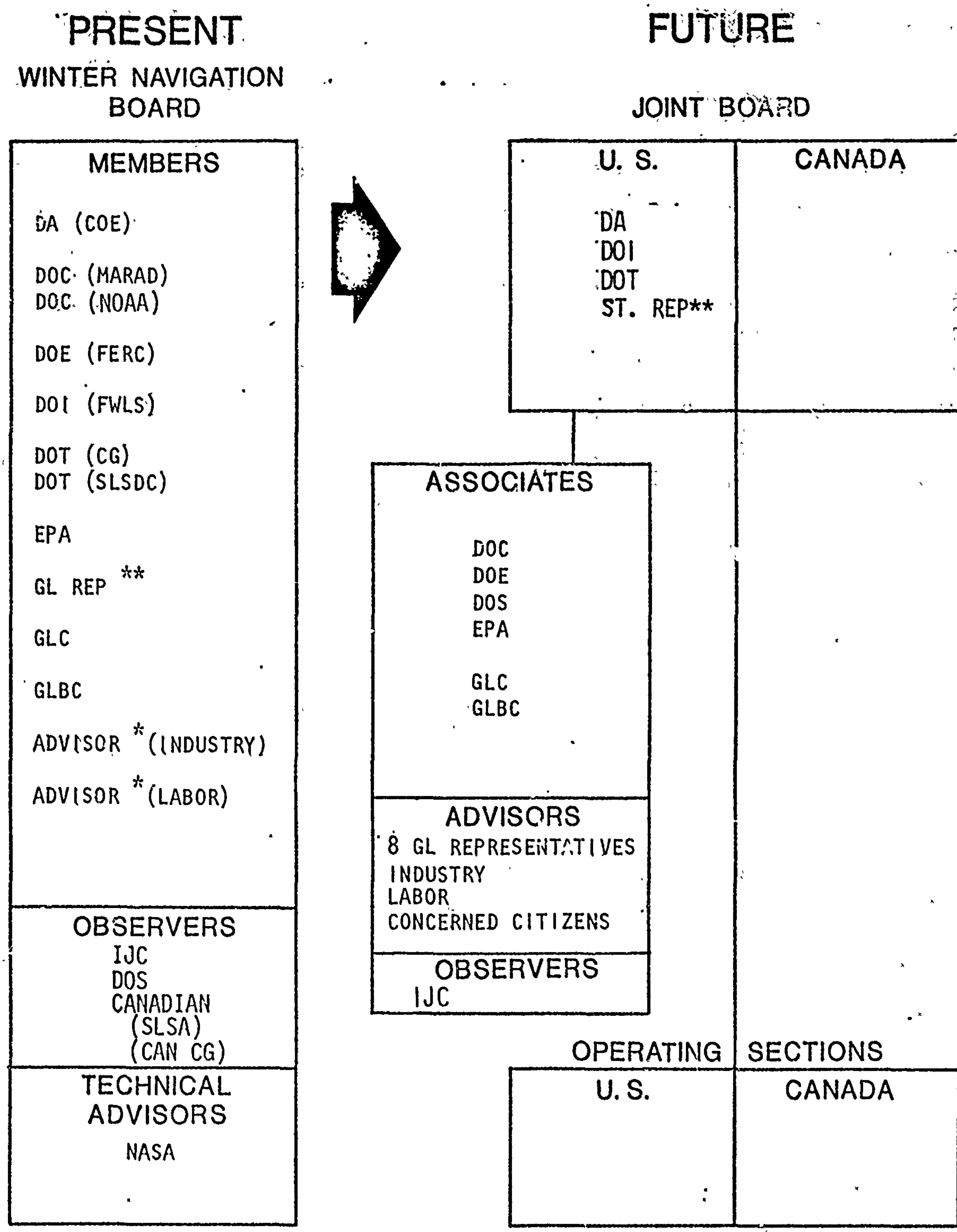
so as to facilitate the coordination and decision-making, and -- not the least -- was the smallness of its size, two members only for each Nation, giving it the ability for responsive decision-making.

These favorable characteristics of the St. Lawrence Joint Board are important to consider when presenting options for the composition of a joint board in the future to oversee extended season navigation. One option is to keep the number of members to something near the size of the successful St. Lawrence River Joint Board, remembering that Canadian participation needs to be allowed for (See Option One shown in Figure 4). One of the four permanent members to the U.S. Section of the Joint Board under Option One would be a State representative. Specific requests have been made by the States of Michigan and New York to assure their representation in such a Board when matters under their jurisdiction come under consideration. It is proposed that a representative from Michigan serve in the capacity of State representative when matters concerning the upper four Great Lakes are to be considered by the Joint Board, and that a New York representative serve in this capacity when issues relating to Lake Ontario and the St. Lawrence River are discussed. Whichever State representative sat on the Board could also represent the interests of the other Great Lakes States. Other agencies and bodies which have participated on the present Winter Navigation Board would continue to make important contributions as associates to the future board. Associates would have specific responsibilities for advising the board in their respective areas of expertise. They would continue to participate fully in providing input on the issues to be considered by the board.

Options Two and Three, shown in Figures 5 and 6, respectively increase the number of members on a future board (from four U.S. members in Option One, to five in Option Two, to seven in Option Three), while the number of associates are correspondingly reduced.

In all three options, non-governmental entities, such as industry and labor representatives and private citizens would function as advisors to a

JOINT BOARD OPTION NO. 1



* APPOINTED BY ADVISORY GROUP

** REPRESENTS ALL GL STATES
FOR UPPER FOUR LAKES-MICHIGAN
FOR LAKE ONTARIO AND ST. LAWRENCE RIVER-NEW YORK

***See Figure 7 for proposed composition of Operating Sections

Figure 4

future board. As these are the people and organizations most directly affected by extended season operations in the field, their direct involvement in the consideration of issues would continue to be essential.

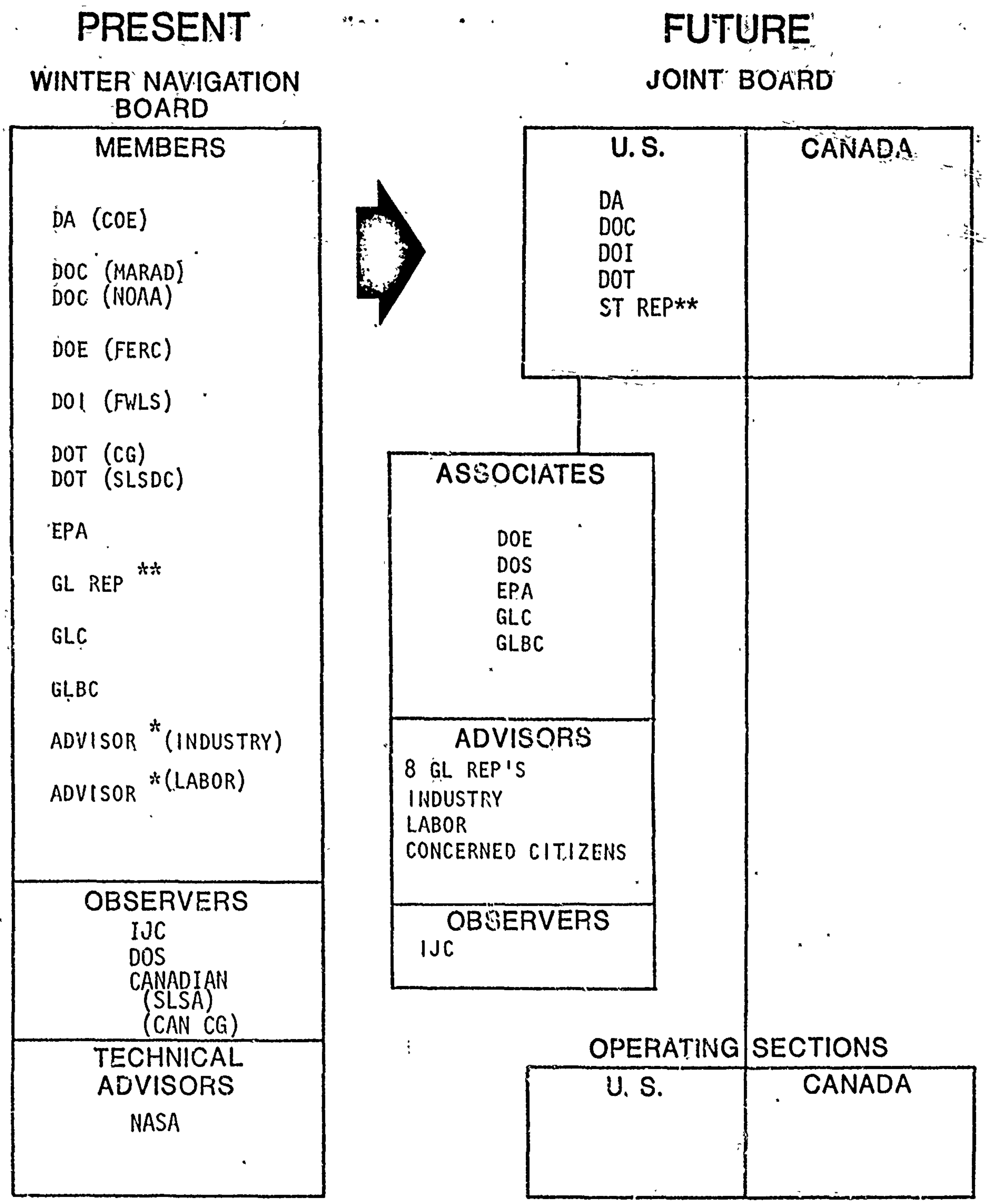
These options provide a wide range of choices for any Joint Board and almost any intermediate selection could be made. The key criteria for establishing the board should continue to be the ability to guide and superintend the program with reasonable speed of decision-making while providing for the access of important interests. Under any of the Options, all of the groups, be they associates, advisers, or observers, have an important role to play to provide their input into the decision-making process. All three options provide the input and access needed. However, Option One is favored because it provides best for timely decision-making and economy in operation.

It is assumed that, whatever superintending body is established, it will cooperatively work with and capitalize on the current authorities, capability, and working relationship of the Seaway Entities (St. Lawrence Seaway Development Corporation and St. Lawrence Seaway Authority of Canada).

Regardless of the precise formulation of the Joint Board it is anticipated some sort of operating section would be established on-site to handle the immediate and hour-to-hour functions of the Joint Board. Such an operating section might be organized as in Figure 7, where one sees both the U.S. and Canadian operating section, each with a chief and staffed as required. The authorization for an operating sub-section is necessary, but the detailed organization and sub-organization should be left to the Joint Board to provide the Board sufficient flexibility to best accomplish its mission.

Once transportation system improvements have been completed, and methods developed and proved in facilitating extending navigation season

JOINT BOARD OPTION NO. 2



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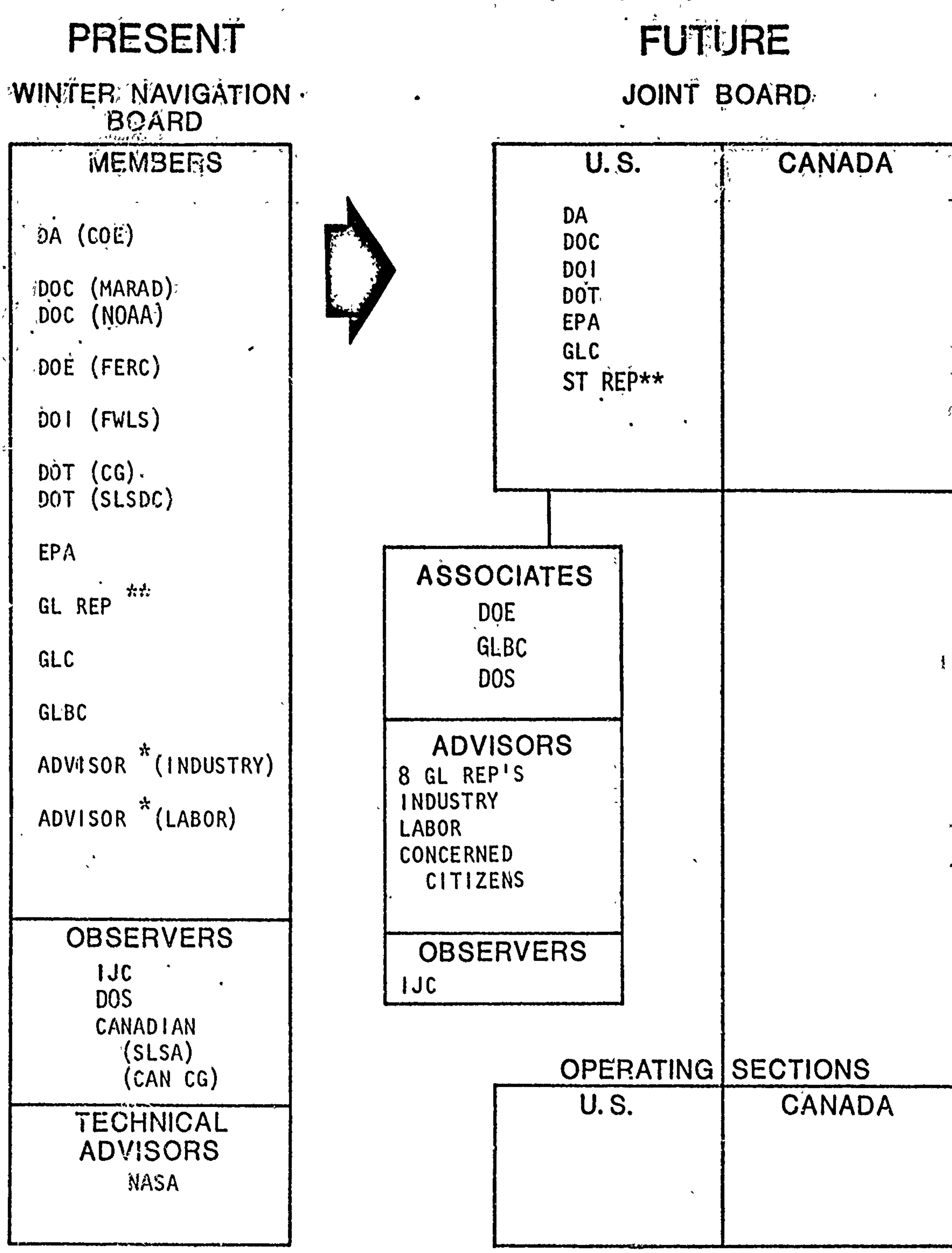
FOR LAKE ONTARIO AND ST. LAWRENCE RIVER-NEW YORK

***See Figure 7 for proposed composition of Operating Sections

Figure 5

JOINT BOARD OPTION NO. 3



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FOR LAKE ONTARIO AND ST. LAWRENCE RIVER-NEW YORK

***See Figure 7 for proposed composition of Operating Sections

Figure 6

operations, a future U.S. section of the Joint Board would submit a final validation report on the program to Congress. At that time, it is expected that the Board would be disestablished, its mission of organizing and developing the program having been accomplished. Participating agencies could subsequently monitor extended season operations as a normal part of their operations.

Transition Group. Because new authorization for extended season navigation on the upper four Great Lakes may not be enacted prior to the winter of 1979-80 an Interim Winter Board has been established to coordinate season closure, agency programming actions, and provide a forum for keeping the public informed of winter navigation activities. The board would function to provide such a forum until the Congress and the Administration provide final direction. The Board is constituted as recommended by the Governor of Michigan for permanent direction, implemented by the recommendation of the Winter Navigation Board, and is composed of the U.S. Army Corps of Engineers, the U.S. Coast Guard, the State of Michigan, the Great Lakes Commission and representatives of industry and labor.

The Winter Navigation Board in its final official meeting on 6-7 August 1979, under the Charter of the Memorandum of Understanding, resolved that such an Interim Winter Board be established and that it function under a memorandum of agreement of the principal responsible agencies at field operating activity level previously identified.

In this action, the Winter Navigation Board recognizes a responsibility to the public and to private interests to provide a continuing forum for matters pertaining to extended season navigation on the upper four Great Lakes and a coordinating mechanism in the interest of supporting navigation and energy conservation needs and in addressing related social and environmental concerns.

JOINT BOARD OPERATING SECTIONS

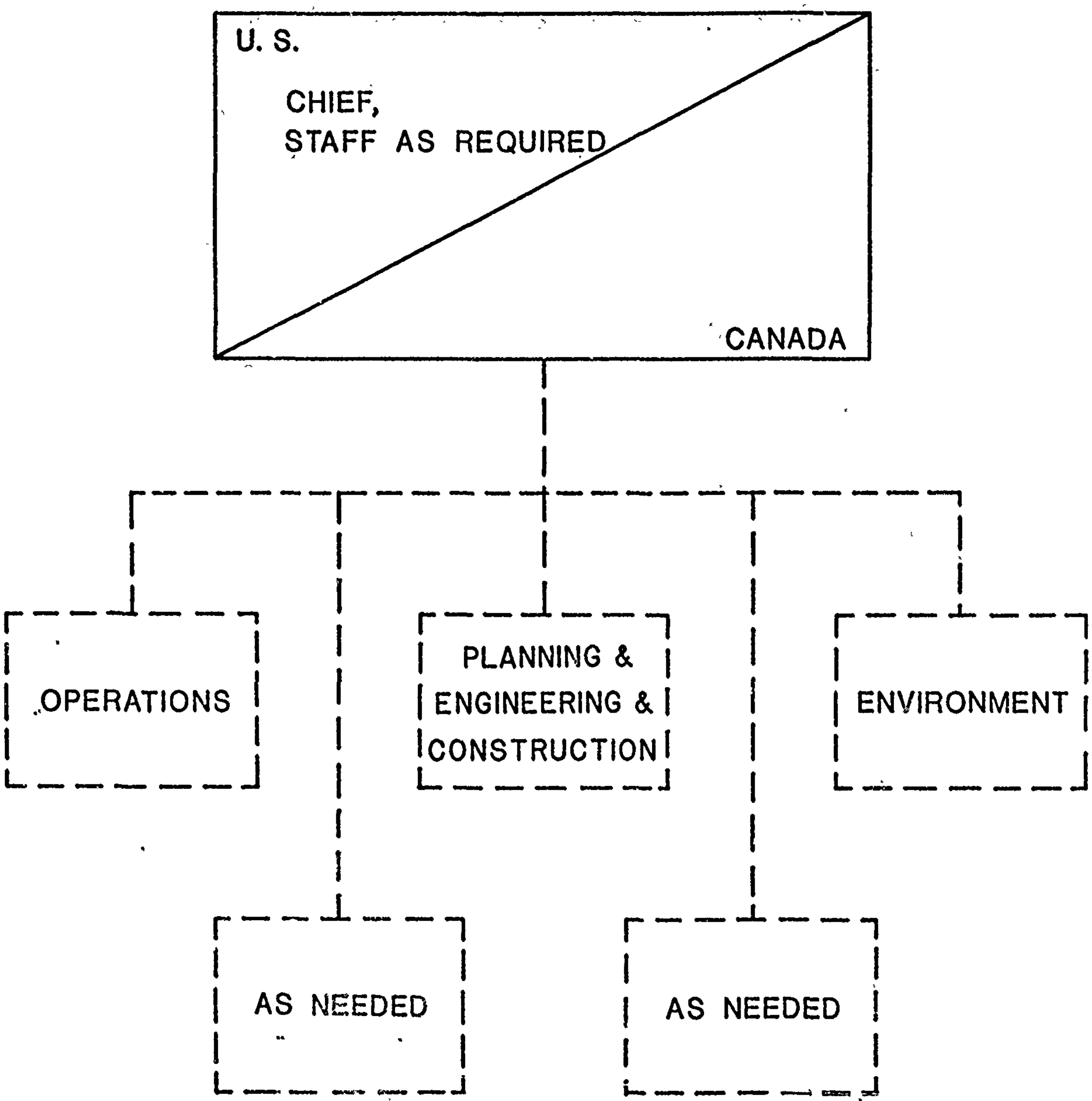


Figure 7

The Winter Navigation Board also resolved that an Interagency Task Force be established to support the Interim Winter Board on matters relating to environmental and ecological effects.

The Winter Navigation Board further and finally resolved that all members and observers of the Winter Navigation Board be invited as observers to the operations of the Interim Winter Board and the supporting Interagency Task Force.

Coastal Zone Management

Plans and activities under an extended navigation season program would be prepared so that conformity with the goals and objectives of the Coastal Zone Management Act is achieved. Coordination with State coastal offices is necessary for all projects which may affect the coastal zones, including the navigation season extension program. This coordination is effected through the Environmental Impact Statement procedures with State Departments of Natural Resources. At present, only two of the eight Great Lakes States (Michigan and Wisconsin) have approved Coastal Zone Management Programs. In this pre-operational phase of the project, since design and construction operations are not definitively known, consistency with individual states' CZM programs cannot be finally established. However, under the Adaptive Method, the impacts on specific coastal areas would be assessed once they were identified in the detailed plans and specifications.

RECOMMENDED PLAN

This section presents the recommended plan for a fully operational season extension program to 12 months on the upper three Great Lakes, up to 12 months on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to a 10-month navigation season on the International Section of the St. Lawrence River. This plan would be implemented in phases as discussed earlier in the paragraph entitled "PHASED IMPLEMENTATION". It is accompanied by an Environmental Plan of Action which provides for an Adaptive Method for confirming the environmental feasibility of an extended navigation season program to be accomplished concurrently with the implementation of an authorized program and execution of post-authorization planning, construction and operations. The Adaptive Method includes an adaptive environmental assessment technique, recommended by the U.S. Fish and Wildlife Service, which includes provisions for engineering and operational refinement based on environmental information (both current and as developed). The program is described below by a section entitled "System Considerations," followed by a section entitled "Site-Specific Considerations," which presents required modifications to the systems starting at the head of the Great Lakes, Lake Superior, and proceeding through Lakes Huron, Michigan, Erie, Ontario, and their connecting channels and the St. Lawrence River to Montreal, Canada. The modifications described are those of the recommended plan. Further details for the modifications are presented in Appendix B. Additionally, in Appendix B an effort is made, when practicable, to present a number of alternative solutions to problems and to explain the rationale for selection of the recommended alternatives.

SYSTEM CONSIDERATIONS

All-weather aids to navigation are necessary for the navigator to accurately determine his position and to assist him in effecting a

safe transit of open waters of the Great Lakes. The LORAN-C radio navigation system being implemented as part of the U.S. Department of Transportation's national plan for navigation, will be available. As the requirement for having LORAN-C receiving equipment on board vessels by 1 June 1981 is met, the mariner will have available a twelve-month all-weather navigation system, in addition to the existing system of major lake coast lights, radio beacons, fog signals, and radar transponder beacons (RACONS). In addition, a mini LORAN-C radio navigation system is recommended for the Whitefish Bay, St. Marys River area, and the St. Clair River-Lake St. Clair-Detroit River area. This system is currently being calibrated in the area from Whitefish Bay in eastern Lake Superior to DeTour Passage at the lower end of the St. Marys River. The full implementation of the complete mini LORAN-C system would be dependent upon renewal of earlier or new agreements with the Canadian Government for installation and maintenance in that part of the system in Canadian territory. Similarly, a precise all-weather navigation system is required for the St. Lawrence River.

In order to compensate for the absence of lighted buoys and radar reflectors, which are traditionally removed from the waters during late November and December to prevent damage or loss of the aids during the winter, a system of fixed navigation light structures, some of which are equipped with radar transponder beacons and radar reflectors, is recommended. The locations of these improvements are described in the "Site-Specific Considerations" section, which follows.

During extended shipping operations, the need for winter weather and ice data collection and dissemination is intensive. This need was identified during the Winter Navigation Demonstration Program, and an Ice Navigation Center was developed at the Ninth Coast Guard District Headquarters in Cleveland, Ohio. It 's recommended that this Ice Navigation Center be an integral part of the Extended Season

Navigation on the Great Lakes/St. Lawrence Seaway System and continue to provide near real-time information to shippers at a level commensurate with extended season shipping activity. Data would be obtained from many sources; aircraft ice reconnaissance would provide weekly coverage of ice problem areas. This reconnaissance effort by Coast Guard aircraft, with radar capabilities, would be scheduled on a regular basis to document ice and weather conditions. These flights would be conducted as often as necessary to provide needed coverage. This proposed Side Looking Airborne Radar (SLAR) coverage is less dependent on weather than visual reconnaissance. Of the U.S. Coast Guard shore units around the Great Lakes, forty units would be principal sources of data. Ice reports would also be made by commercial and Coast Guard ships. The National Environmental Satellite Service would supplement low-level aircraft and ground reconnaissance data with satellite photographs. The National Weather Service, supported by the National Oceanic and Atmospheric Administration, would provide ice and weather forecasts and advisories.

Since there is no reliable way to determine if a vessel has been damaged or even lost (aside from the vessel's communicating its own distress signal), until the vessel is overdue at its destination or until it has failed to file a routine report with its owners, an emergency position indicating radio beacon (EPIRB) is being recommended. Each vessel sailing in the extended season would be fitted, at the owner's expense, with an automatic device which would transmit an alerting signal for a short period on Channel 16 VHF-FM and a homing signal on Channel 15 VHF-FM. Coast Guard units are currently being equipped with homing and direction-finding equipment. (These installations are not contingent upon winter navigation.) Additionally, a Great Lakes automated vessel reporting system is recommended for the period 1 December through 30 April. This computer system utilizes computer analyzed reports to enable the task

group to coordinate vessel movements to form convoys and dispatch needed icebreakers.

A vital part of extended season navigation is icebreaking support by vessels with icebreaking capabilities to render assistance to vessels whenever they are beset in ice or in need of assistance to transit through the ice. The U.S. Coast Guard, with its Great Lakes headquarters (Ninth District) located at Cleveland, Ohio, has traditionally provided this support. Currently, thirteen (13) Coast Guard vessels are engaged in icebreaking activities. This total includes two Type B vessels which are the MACKINAW and a polar class breaker; six Type C vessels which consist of four 140 foot and two 110 foot tugs; and five Type D buoy tenders. The Type B icebreakers are capable of breaking two to three feet of ice without backing and ramming. The 140 foot Type C vessels are specially equipped for icebreaking and are capable of breaking 1.5 to 2 feet of ice without backing and ramming. The Type D buoy tenders do not have significant icebreaking capability.

The Coast Guard's estimates of additional future icebreaking vessel requirements for the recommended plan are a total of four Type B and 20 Type C icebreakers. The areas of operation are:

Location	Type B	Type C
Western Lake Superior to the Straits of Mackinac	2	7
Lake Michigan	-	2
Lake Huron, St. Clair and Detroit Rivers, and Lakes St. Clair and Erie	2	7
Lake Ontario and the International Section of the St. Lawrence River	-	4

The major icebreakers (Type B) are deployed at strategic points in the lakes along major shipping routes and in areas of heavy ice concentration. These locations, along with Type C facilities, are more specifically described in the following "Site-Specific Considerations" section.

During the summer months, these vessels would be used for search and rescue, law enforcement, boating safety, and maintaining aids to navigation. It is for this reason that only 50 percent of the capital cost of new icebreakers is apportioned to extended season navigation.

The potential for a major marine incident due to ice does exist. The U.S. Coast Guard performed a review of the record of previous reportable vessel casualties. Even though vessels not designed to operate in the ice are doing so, the above review suggests that no new regulations are necessary. The Coast Guard draws its vessel hull strengthening and powering requirements from the American Bureau of Shipping rules for building and classing steel vessels. These rules offer eight various classifications for operating in ice, including such areas as hull strengthening, increased power, strength of rudders and steering gears, and special arrangements for sea chests to prevent freeze-up, as well as special materials for and design of propellers. Although this classification option is available to owners, they are not required to attain any specific ice classification for their ships presently operating in winter conditions in the Great Lakes. As traffic levels increase in the future, however, regulations for the strengthening of hulls, reduction gears, rudder stocks, and propellers may be required. Otherwise, the limited number of icebreakers available may necessitate restricting operation of vessels in ice.

In the area of crew safety and survival, technical developments have either been completed or are nearing completion. Technical requirements are either established or in their final development. The task that remains is to introduce necessary changes in the Coast Guard regulations through the process of legal review, publication of proposed rules, evaluation of public comment, additional legal review, and the final rule publication. The Coast Guard will continue the process of translating the technical developments into proposed and final rules. One result of the climatological and environmental studies was the realization that hazards to the crew were as great during parts of the normal navigation season as during the extended season. Therefore, the regulation changes that will be proposed will apply, for the most part, to the inspected vessels on the Great Lakes in general and not just to those operating during the extended season. Regulation projects that are in progress at this time include provisions for:

a. Exposure suits for all personnel on board;

b. Inclosed survival craft capable of being launched with all persons aboard;

c. Emergency position indicating radio beacons for vessels and survival craft; and

d. Improved crew training and drill requirements, including instruction in cold water survival techniques.

In the area of vessel speed control and enforcement, speed regulations are the responsibility of the U.S. Coast Guard and the St. Lawrence Seaway Development Corporation. Speeds are monitored using Doppler radar or by measuring the time a vessel travels its own

length during normal and winter navigation. Penalties are assessed for violations. Since many allegations have been made that vessels are traveling at a speed in excess of the legal speed limit, it is proposed that the vessel speed monitoring, that the monitoring of shoreline erosion, and that a continual assessment of reports on property damage continue, with a view toward adjusting speed limits, should experience indicate it necessary. Vessel operators will continue to be responsible for negligent shore property damage; this will continue to place financial burden directly on responsible parties. The decisions regarding the cause of damages, either natural or vessel wake, will continue to be determined on a case-by-case basis.

Since there cannot be an absolute guarantee that it could not happen, the potential for oil spill occuring during an extended season program does exist. For a number of reasons, that potential is lower in stable ice conditions and higher during spring breakup when the ice is moving downstream in rivers and bays near rivers. Under the various circumstances which could occur during a spill, the containment and clean-up operations could be either less difficult or more difficult than similar operations taking place during warmer weather.

Although the U.S. waters of the Great Lakes have never experienced a catastrophic oil spill exceeding 100,000 gallons and no vessel related spills of significance have occurred during winter operations, a spill could be locally devastating to fisheries and wildlife.

The U.S. Coast Guard has developed a number of excellent contingency plans for spill clean-up and containment. Response time has been reduced to a few hours and good equipment is available. However, based on comments received on the Draft Report,

Environmental Impact Statement, and the numerous public workshops and meetings, it appears that the public and agencies with the primary mission of protecting natural resources strongly desire further improvement of the ability to handle oil or toxic material spills. These agencies and the public have highlighted potential problems and the situation dictates that technology, contingency plans and equipment continue to be improved to afford better protection for water quality and fish and wildlife resources which are essential to the health and economic well-being of much of the population of the Great Lakes Basin. These resources also form the basis of a multi-billion dollar tourist and recreation industry. Therefore, continued improvement of technology, technology transfer contingency plans and equipment is warranted and is recommended under the Environmental Plan of Action to afford the level of protection desired by the public.

Vessel Waste Discharge Requirements (Blackwater, Graywater): Blackwater is defined as human body wastes collected from urinals and toilets onboard commercial vessels. Regulation of the discharge of blackwater from commercial vessels is based on the Federal Water Pollution Control Act of 1972, and The Clean Water Act of 1977. Both new and existing vessels must comply with Federal regulations (treatment or holding of blackwater wastes) by January 30, 1980.

A study was conducted and a report was prepared to assess the effects of navigation season extension on blackwater waste disposal generated onboard Great Lakes commercial vessels. The report's findings on navigation season extension were as follows:

a. Was not seen to have a serious impact on shoreside disposal facilities;

b. Would have little effect on shipboard marine sanitation devices (MSDs);

c. Was found to have negligible long term effects;

d. May cause adverse conditions, in the short term, especially in harbors and embankments; and

e. Was not seen to create substantial economic penalties for shipowners due to the addition of MSDs.

Many ports surveyed lack adequate disposal facilities. Should "no-discharge" regulations by states become widespread, additional shoreside facilities would be reqired. Legislation regarding vessel blackwater waste will not create substantial economic penalties to shipowners due to the addition of sewage holding tanks.

Non-human or graywater discharge refers to that vessel waste from galley, laundry, shower, sinks and other miscellaneous drains. Existing agreement with Canada precludes wastewater from being discharged by vessels into waters of the Great Lakes in deleterious amounts or concentrations. The Clean Water Act of 1977 states that in the future, "sewage" will be redefined to include graywater from Great Lakes vessels only. The Act further states that the EPA shall establish standards for the same that will require at a minimum the equivalent of secondary treatment.

A study was conducted and a report was prepared to assess the effects of winter navigation on the Great Lakes on vessel graywater waste disposal. The report determined that navigation season extension:

a. Was not seen to have a serious impact on shoreside disposal facilities;

b. Would have little effect on shipboard marine sanitations devices (MSDs);

c. Was found to have negligible long term effects; and

d. May cause adverse effects in the short-term, in sensitive

coastal environments and harbors due to low rates of dispersion and dilution.

MSD's are designed to accept blackwater and are not adequate to handle the substantial additional graywater loadings. Therefore, legislation on vessel graywater waste would cause an economic impact for shipowners in the costs incurred to purchase MSD's large enough to handle both black and graywater.

In addition, vessels unavoidably produce several types of pollutants which must be disposed of in some manner. These types include blackwater and graywater, as discussed, and in addition: bilge waste, ballast water, solid waste and air pollutants.

Bilge waste water is not presently regulated by legislation. The environmental impacts of oil-contaminated bilge wastes are not known, as no specific studies have been done. It is assumed that when and if bilge waste is regulated that such regulation will appropriately encompass season extension.

Ballast water is not considered a significant source of pollution, and no adverse effects of additional ballast discharge are anticipated as a result of navigation season extension.

The Federal Clean Air Act sets forth National Ambient Air Quality Standards, defining maximum allowable ambient concentrations for certain pollutants. The impacts of navigation season extension are not presently perceived to significantly alter the air quality of the Great Lakes region.

In order to enhance the capabilities of ship masters operating during the extended navigation season, a comprehensive training program for Vessel Captain/Pilot Training would be undertaken by

industry, labor and appropriate Federal agencies. In addition to a formal training phase, including films, manuals, charts, etc., primary emphasis would be placed on progressive on-the-job training. To gain maximum benefit from previous winter navigation experience, an information exchange program would be organized, highlighted by observation trips on vessels sailing in ice conditions.

Courses of Action have been formulated to ascertain ways of providing riparian owners with relief from alleged shore erosion and shore structure damage associated with the Great Lakes-St. Lawrence Seaway Navigation Program.

In view of findings in the Chief of Engineers' report dated 16 November 1977 on the March 1976 Interim Feasibility Report, certain mitigative measures (structural or compensation) are recommended for land and structure damages incurred as a result of winter navigation. The Report cites that the Federal Government should be responsible for shore structure and shore erosion damage, caused by winter navigation, which occurs above the ordinary high water mark, if any.

In addition, preventative measures that can be taken to reduce shore erosion are an important element in plans to minimize the negative effects of an extended navigation season. Federal protection of environmentally high-risk areas, vessel speed control, vessel route regulations, and the regulation of vessel movement through unstable ice fields are viable ways of sharing the responsibility for minimizing negative effects associated with shore erosion and shore structure damage.

However, for land and structure damages incurred as a result of winter navigation, below the ordinary high water mark, the doctrine of navigation servitude applies. Thus, unless some new legislation

is enacted, the Federal Government would not be liable for any damage resulting to land and structures below the ordinary high water mark and, therefore, cannot compensate the owner.

To be accomplished concurrently with, and as a part of, the advanced engineering and design, construction and operation phases of the authorized project is an Environmental Plan of Action consisting of environmental base condition data collection, evaluation and assessment, monitoring and validation--which should lead to environmental compensation, mitigation and possible enhancement. The EPOA suggests that a system-wide study be conducted on endangered and threatened species and their critical habitat. Existing data would be compiled and additional field work performed. Further investigation would take place where activities may require an environmental document.

The Environmental Plan of Action is based on the principle that the Extended Season Program would be modified and, if necessary, suspended should unacceptable environmental impacts be encountered. These unacceptable environmental impacts could be identified during any of the post-authorization phases, including design studies, construction or operation. The intent is to identify all possible impacts during Phase I of the design studies.

The EPOA includes methods for assessing environmental impacts, studies to be conducted, and estimates of study costs. The EPOA also includes an integrated environmental study and engineering schedule, the outline of a system for managing data, and a description of an overall system for selecting and scheduling studies so that the needed information would be available at a suitable time for environmental assessment and planning. The EPOA would be refined throughout the Extended Season Program as new information and insights are gained.

The EPOA is a major facet of the Adaptive Method procedure to be used in the Extended Season Program, which provides the necessary checks and balances to assure protection of the environment.

To further explain the schedule and procedures to be followed, completion of this Survey Report is scheduled for Fiscal Year 1980. The earliest Congressional authorization and appropriation of funds are anticipated about 1982, should the Congress decide to authorize the recommended program. However, since the actual time for authorization is unknown, the existing schedule designates this point as year zero for scheduling subsequent activities and reports.

At year zero, following appropriations, the COE would begin several geographically oriented detailed planning studies concurrently with obtaining base condition and inventory data. After a period of up to 3-5 years, sufficient information (environmental, engineering, etc.) would have been developed to make engineering decisions and to allow final preparation of an EIS which would accompany its mutually supporting Phase I General Design Memorandum (GDM) to higher COE authority for approval. This EIS would be based on evaluation of the base condition data from both site-specific and system-wide studies. Using the FWS Assessment Methodology Technique, the EIS would predict all impacts known at that time resulting from the program and would provide details on monitoring considered necessary to guard against unanticipated adverse impacts.

Also important in the COE Adaptive Method is the commitment that should the assessment indicate a need, the design of an item or planned activity could be modified during Phase I planning to mitigate, compensate or eliminate adverse impacts.

After approval of the Phase I GDM and EIS, the COE would begin Phase II studies which are detailed engineering design studies leading to preparation of plans and specifications. System-wide studies would continue during this period. At some point, about two years before construction is scheduled to begin, the environmental base condition would be verified and updated in preparation for monitoring during construction and operation. Should the design be significantly altered or new information be developed showing a probability of a previously unanticipated impact, a new EIS would be prepared prior to construction. In addition, it is likely that for a major construction activity, such as compensating works, a Feature Design Memorandum (FDM) would be prepared. This FDM would describe only one item of construction and also would require the preparation of an EIS if the structure were altered significantly from previously described plans or if new potential impacts of the structure came to light since the previous EIS was completed.

During construction and operation, environmental monitoring would be accomplished as a check on impact predictions and as a safeguard against unanticipated adverse impacts. The monitoring would compare the post-construction environmental conditions with pre-construction conditions. Should the monitoring indicate that a significant impact is occurring, any of several things would be done, depending on the nature of the impact. If the impact is found unacceptable, the cause would be eliminated, even to the halting of vessel traffic. If a lesser measure would accomplish a satisfactory result, it would be done. If an impact develops which is considered acceptable but undesirable, appropriate measures would be taken to mitigate, compensate or eliminate the impact; however, halting vessel transits would not be considered.

There would be several Phase I GDM studies running concurrently, but these would not necessarily be started simultaneously. One phase

of the recommended implementation is for year-round navigation on the upper four Great Lakes. Another phase of implementation would be that of achieving navigation season extension on the St. Lawrence River.

A Validation Report would be completed for each phase of implementation. A Final Validation Report would be written summarizing all preceding reports. These would be prepared after monitoring indicated that all impacts had been identified and evaluated and all efforts at compensating, eliminating or mitigating impacts had been taken. The Validation Reports would review the information obtained and recommend whether or not operation should continue. The Final Validation Report would provide the answer on the environmental acceptability of the Extended Season Program or any phase of the program.

Social considerations include the need to undertake an additional recreational study and an additional sociological study during the advanced engineering and design stage (Phase I GDM) of the Season Extension Program. The recreational study would establish the magnitude of winter recreation near extended season routes based on the distance traveled to the site, the number of participants, the amount of money spent, and those benefiting economically from these activities. The sociological study would monitor selected areas to document the gross social effects of extended season operations on various types of communities and occupational groups.

The need of island residents in the winter to have direct and unimpeded access to mainland areas is another social consideration. Proposed solutions for each of the islands affected are contained in the "Site-Specific Considerations" section.

SITE-SPECIFIC CONSIDERATIONS

Lake Superior

Winter shipping on Lake Superior is expected to be from U.S. harbors through the Soo Locks. U.S. harbors proposed to have season extension traffic at this time are: Taconite, Two Harbors, and Silver Bay, Minnesota; Ashland, Wisconsin; Marquette/Presque Isle, Michigan; and Duluth-Superior, Minnesota-Wisconsin. Canadian winter shipping is also expected to flow from Thunder Bay and Michipicoten through the Soo Locks. Detailed studies of each of the Lake Superior U.S. harbors have been made to determine what modifications are required to facilitate winter navigation in those harbors. It has been determined that no harbor improvements are required for Taconite, Two Harbors, and Presque Isle and that only a single line of bubblers would be required in Ashland, Marquette, and Silver Bay Harbors. Ashland and Marquette Harbors would also require the use of a commercial high power icebreaking tug. Duluth-Superior Harbor would require the installation of a system of thirteen bubblers, the use of an icebreaking tug, the addition of six harbor navigation lights, and a channel clearing craft.

Icebreaker assistance would be required in Lake Superior to escort vessels through ice packs, particularly at the western and eastern ends of the lake. Mooring facilities would be required for Type B icebreaking vessels at Duluth-Superior, Minnesota-Wisconsin.

St Marys River

U.S. Coast Guard icebreaking assistance and escort services for the entire river system would be required. Mooring facilities for one Type B and five Type C icebreakers are recommended at Sault Ste. Marie, Michigan. Air bubbler systems are planned for tight turns along the St. Marys River; namely, at Birch and Brush Point Angle

Courses where waters from Whitefish Bay enter into the river; at Angle Courses 5 and 6, 6 and 7, 7 and 8, and 8 and 9 of the Middle Neebish Channels; and at the Lime Island Turn. Floating log ice booms are recommended at the head of the Little Rapids Cut to help stabilize the Soo Harbor ice cover. As an additional means of stabilizing Soo Harbor ice and to prevent the ice cover from breaking away from the mainland shore, ice anchoring devices such as small islands are recommended. Additionally, the sewage treatment plant outfall on the south shore of Soo Harbor should probably be extended to a point near the head of the Little Rapids Cut. Winter navigation is currently contemplated only in the downbound course around Pipe Island for both upbound and downbound traffic. This would help minimize the potential disruption of ice cover in this area which is directly above the Drummond Island ferry crossing. Navigation light structures with radar transponder beacons (RACON's) would be required at Birch/Brush Point and Big Point as well as eight fixed navigation light structures at other points in the river.

The use of the West Neebish Channel for winter navigation is not currently proposed. Dredging of the Middle Neebish Channel to permit two-way traffic is being recommended (so as to be completed concurrently at that time in the future when controlled one-way traffic flow is no longer practicable). The eventual dredging would amount to approximately 3,000,000 cubic yards along the 17 mile stretch of the channel. It is planned to dispose of the dredged material by hauling it to an open water area at the head of Lake Huron where the water depths are between 100 and 150 feet. A traffic control system to monitor and control upbound and downbound traffic in the Middle Neebish Channel is recommended. To insure that the impact of winter navigation on island transportation is minimal, a detailed study was performed at Sugar Island, Lime Island, and Drummond Island. Measures, where necessary, are recommended which would minimize the impact of winter navigation on island

transportation. At Lime Island, extended operation of an airboat is recommended. This airboat is recommended under the March 1976 Interim Report recommending season extension on the upper four Great Lakes to 31 January ($\pm$ 2 weeks). At Drummond Island, no modifications are recommended based on studies conducted during the Demonstration Program; however, further monitoring and study would be done and should there be impacts attributable to extended season operations identified, mitigation measures would be considered. To allow winter pilot transfer operations at DeTour, the existing, privately owned, transfer boat would have to be replaced by the owner with an icebreaking tug. Additionally, operational plans are being considered and/or developed for implementation to enable continual transportation between the mainland and these islands.

The formation and build-up of ice in the adjoining channels to the Soo Locks present major obstacles to winter navigation. Alterations at lock entrances, in lock chambers, and other lock facilities are recommended to overcome these obstacles. Ice control devices at lock entrances are needed. These control devices would consist of: (1) air bubbler systems along entrance channels to suppress ice cover in the channel and ice build-up on approach wall structures, and (2) an air curtain system across upstream lock entrances to minimize the amount of ice that enters the lock with vessels. Ice control devices recommended for the MacArthur and Poe Lock chambers consist of: (1) coatings on lock walls to suppress ice build-up on the walls and provide for easy removal of ice; (2) bubbler/flusher system around lock gates to suppress ice formation and to flush ice out of lock gate recesses during gate operation; (3) heating of lock gates and hydraulic mechanisms to prevent ice build-up on the gates; (4) installing valves in the upstream lock gates to utilize available head to flush ice out of lock chambers; (5) the installation of additional steam outlets at the top of lock walls to assist in the removal of ice collar by steam; and

(6) providing a recess in concrete along lock walls at the ice collar level and installing steam lines to assist in the removal of the ice collar.

Ice prevention measures which are recommended are as follows: (1) the installation of air bubbler lines along lock chamber floor to provide low air pressure bubbling; (2) the installation of heating cables in lock machinery recesses to prevent ice build-up; and (3) air bubbler units installed in lock gate recesses, stop log seals, and dewatering gates.

It is expected that an extended navigation season would require additional lock maintenance due to the increased wear and tear on lock mechanical, structural, and floating plant equipment, which is summarized below:

(1) a new steam plant facility is recommended to replace the existing outdated model and would add additional steam generating capability;

(2) the lock gate vinyl paint surfaces would require painting at more frequent intervals due to abrasion action from moving ice;

(3) two new 2000 CFM air compressors would be needed to replace older obsolete units;

(4) the normal lock maintenance schedule will require revision and be phased over the entire year;

(5) construction of a permanent enclosure around the Poe Lock safety fender boom, rolling segments;

(6) construction of panels at the boom tip to prohibit blowing snow from drifting into socket receiver;

(7) the floor drains in the two Poe Lock chamber fender boom recesses will require modification and installation of heating cables; and,

(8) it is anticipated that the lock wall fender damage will require additional maintenance cost.

It is anticipated that the extended navigation season will also cause additional wear and tear on Corps of Engineers (COE) floating plant equipment, and that some modifications will be required on existing floating plant. These would include strengthening bow plating and framing modification to fuel tanks to provide "double bottom" characteristics, modifications to existing steering systems, and the installation of enclosures over deck machinery to prevent equipment freeze-ups. Additionally, some of the capital cost of replacements of the COE floating plant are allocated to the winter navigation project cost, as well as a portion of the capital cost of procurement of a COE icebreaking tug.

To assure that there will be an appropriate alert for potential flooding due to ice jams, it is recommended to increase the water level monitoring program.

Straits of Mackinac - Lake Michigan

Ship tracks can best be maintained in the Straits of Mackinac by use of Coast Guard icebreakers. Vessel traffic lanes would be closed between St. Ignace and Mack nac Island.

The Lake Michigan harbors currently foreseen to be an origin or destination for winter navigation traffic are: Green Bay, Port Washington and Milwaukee, Wisconsin; Chicago, and Calumet, Illinois;

Indiana Harbor, Burns Waterway, and Gary, Indiana; Muskegon, Ludington, and Escanaba, Michigan. Detailed studies of the aforementioned harbors indicate that Port Washington, Milwaukee, Chicago, Burns Waterway, and Gary would require no harbor modifications to facilitate winter navigation. It is recommended that Green Bay, Wisconsin, would require the addition of four fixed navigation light structures and an icebreaking tug. Calumet Harbor would also require the installation of four bubblers. Indiana Harbor would require the installation of one ice boom. It is recommended that Muskegon and Ludington harbors would each require the installation of one long-line bubbler as well as commercial tug assistance. Escanaba Harbor would require the installation of five bubblers as well as the use of commercial icebreaking tugs.

Ice conditions on Lake Michigan are most severe in the northern end of the lake. U.S. Coast Guard icebreaking assistance is needed for ships entering Northern harbors. The entire area is subject to shifting ice conditions and icebreakers would be required to provide necessary capability to maintain traffic flow. The level, type, and deployment of icebreaker services has been estimated by the U.S. Coast Guard as mentioned in the System Considerations Section. The U.S. Coast Guard's initial estimate for two mooring facilities are anticipated for Type C icebreakers at Escanaba, Michigan.

Lake Huron - Saginaw Bay

Winter navigation problems on Lake Huron can exist. In a severe winter the ice cover along the western shore of the lake can extend out several miles. Icebreaker assistance is needed on a periodic basis. The level, type, and deployment of needed icebreaking capability has been recommended by the U.S. Coast Guard and is discussed under the System Considerations Section. It is noted that existing facilities are available for Type C icebreakers at St.

Ignace, Michigan. One new facility for a Type C icebreaker is also recommended at St. Ignace and at Port Huron, Michigan.

Harbors along Lake Huron which are currently expected to have winter navigation traffic are: Calcite, Alpena, and Saginaw Harbor, Michigan. Based on detailed winter navigation studies of these harbors, it is recommended that a bubbler and the use of an icebreaking tug be utilized at Calcite Harbor. It is recommended that two bubblers be installed in Alpena Harbor along with one fixed navigation light and that commercial icebreaking tugs be utilized within the harbor. Saginaw Harbor would require the installation of one boom and the utilization of commercial icebreaking tugs within the harbor and the installation of two fixed navigation lights in the bay.

Canadian ships are expected to enter Little Current and Depot Harbor along Georgian Bay and Goderich along the southeastern shore of the lake.

St. Clair River - Lake St. Clair - Detroit River

A system study of this reach has defined several improvements considered necessary to enable year-round navigation. These improvements are: icebreaking assistance, particularly in the lower St. Clair River, Lake St. Clair and the lower Detroit River; an ice control structure is recommended at the head of the St. Clair River to contain ice in Lake Huron and reduce significantly the possibility of ice floes into the river and accumulating in the lower St. Clair River as it now does; an ice control structure at the head of the Detroit River much like that recommended at the head of the St. Clair River; and shore erosion and structure protection and possibly ferry assistance, particularly along the Delta Region of the lower St. Clair. The structures proposed for the heads of the Detroit and St.

Clair Rivers should significantly reduce the risk associated with ice jams and shore structure damage along the rivers compared with naturally occuring conditions.

It has been shown by various investigators that the natural occurrence of ice retardation within the Great Lakes Connecting Channels, such as the St. Clair River and Detroit River, can affect the levels and flows of the system. This natural occurrence is an important factor in the natural water levels existing in the system. Winter navigation would disrupt the ice cover in these reaches and, as a result, would tend to increase or (likely) decrease this retardation which, in turn, might affect the levels and flows. Consequently, it is proposed that compensating works might need to be installed in both the St. Clair and Detroit Rivers to compensate for the affect on ice retardation.

There are several harbors along this reach. The U.S. Harbors expected to have winter navigation traffic are: St. Clair, Detroit, Dearborn/River Rouge, Ecorse and Trenton. Detailed studies indicate that no improvements are considered necessary to enable year-round navigation.

It is recommended that a fixed navigation light with a radar transponder beacon (RACON) be installed in the Lake Huron Cut and the east outer channel of the Detroit River. Additionally, two fixed navigation lights are recommended to be installed in Lake St. Clair.

The level, type and deployment of the needed icebreaking capabilities has been recommended by the U.S. Coast Guard and is discussed under the System Considerations Section. In order to accommodate the icebreakers, mooring improvements are initially recommended in Detroit Harbor for a Type B icebreaker and a two Type C icebreakers.

A study was conducted in 1978 of all ferry crossing sites along the St. Clair River and the Detroit River. No ferry improvements are proposed for these sites due to the minimal impact of winter navigation on their operations. To assure impacts on ferry transportation are minimal, further monitoring and study would be done, and should impacts attributable to extended season operation be identified, mitigation measures would be considered.

The privately owned mail boat currently used to transfer pilots during the open water season on the Detroit River would have to be replaced by the owner with an icebreaking tug to permit pilot transfers in the winter.

Increased water level monitoring operations are recommended to insure that there will be an appropriate alert and action taken to prevent potential flooding due to ice jams in the Detroit and St. Clair Rivers.

Lake Erie

Lake Erie, or most of it, being the shallowest of the Great Lakes, is likely to freeze completely over during winter months. Navigation is primarily from the upper lakes into harbors located along the south shore of the lake. Icebreaking assistance and escort service are considered essential on the western end of Lake Erie, to maintain a broken ice track to Toledo and Monroe Harbors; to and through Pelee Passage, to maintain the main navigation channel ice track; and on the eastern end of Lake Erie. Shifting ice conditions are a major problem on Lake Erie, particularly along the south shore harbor entrances and in the eastern portion of the lake. Because of its shallowness, navigation through the lake, especially on the eastern end, can be very difficult during the spring break-up period when ice turns to a slush condition. Icebreaking is required because even high powered vessels can have considerable difficulty moving in

these conditions. Necessary icebreaking requirements for this reach have been recommended by the U.S. Coast Guard and discussed under the System Considerations Section. To accommodate the icebreaking vessels, mooring improvements are recommended in Cleveland Harbor for a Type B icebreaker. Also, two mooring facilities at Toledo, Ohio, one facility at Cleveland, Ohio, and one facility at Buffalo, New York, for Type C icebreakers are recommended.

The Lake Erie U.S. harbors currently foreseen to have winter navigation traffic are: Monroe, Michigan; Toledo, Sandusky, Huron, Lorain, Cleveland, Ashtabula and Conneaut, Ohio; and Buffalo, New York. Canadian harbors are: Nanticoke and Port Colborne.

Shifting ice conditions associated with wind and storm driven ice on the lake cause an ice management/control problem at harbor entrances. The problem, duration and frequency are directly related to wind conditions. Detailed studies have been conducted and floating ice control structures at the harbor entrances of Lorain, Cleveland, Conneaut, Ashtabula, and Huron, Ohio, are recommended. Inner harbor bubbler systems are recommended for the harbors of Monroe, Michigan; and Sandusky and Huron, Ohio. Commercial icebreaking tug assistance is recommended at Monroe, Michigan; Toledo and Huron, Ohio; and Buffalo, New York; with a high power icebreaker tug recommended at Sandusky, Ohio. A fixed navigation light with a radar transponder beacon is recommended at Toledo.

Welland Canal (all Canadian)

Although the Welland Canal is all Canadian and there are no U.S. costs associated with operation of the Canal, the following discussion is presented to display consideration being given by the Canadians on improving their portion of the Lakes-Seaway System.

The harbor at Port Colborne, Ontario, is situated on Lake Erie and is the upstream entrance to the Welland Canal. Difficulties could be expected with ice being broken loose by vessels entering and leaving the harbor and by wind blown ice entering the harbor. The installation of a system of flow developers and ice diversion works are being considered by the Canadians.

Within the lock system itself, problems related to gate opening and closing and ice accumulation within the locks and canals could be expected. The installation of heaters and bubblers at the gates and gate recesses would allow the gates to operate throughout the winter. The installation of flow developers and the lockage of excess ice through the lock system should maintain the locks and canal in a satisfactory operating condition.

Niagara River

No winter navigation traffic is expected on the Niagara River. The existing ice boom, installed jointly by the U.S. and Canadian power entities on the Niagara River across the head of the Niagara River reduces the occurrence and duration of ice runs from Lake Erie into the river which can cause clogging of power intakes and damages to river shoreline properties. It is unlikely that any ice floes loosened by vessel passage in the lake above the boom could reach this area to have any adverse effect on the river.

Lake Ontario

Lake Ontario, except for the eastern end, is not likely to freeze completely over during the winter months. Navigation is primarily through traffic between the Welland Canal and the St. Lawrence River, with some traffic to the United States and Canadian harbors. Necessary icebreaking requirements for this lake have been recommended by the U.S. Coast Guard and are discussed under the

System Considerations Section. To accommodate the icebreaking vessels, one mooring facility is recommended at Oswego, New York, Type C icebreakers. Canadian harbors which may attract winter traffic include Hamilton, Port Credit, Toronto, Oshawa, Picton, and Bath.

International Section, St. Lawrence River

At Cape Vincent, the privately owned pilot transfer boats currently used exclusively in non-ice or minimal ice conditions would have to be replaced by the owner with tugs that have an icebreaking capability. The year-round residents of Grindstone Island who have in the past crossed the river ice to reach the Village of Clayton would now have as an alternative the use of a tug with icebreaking capability under the recommended solution for the residents' winter transportation mode.

The existing ice boom which spans the entire river between Ogdensburg, New York, and Prescott, Ontario, and the boom spanning the navigation channel at Galop Island would require navigation openings with booms parallel to the channel to minimize the passage of ice through the boom opening. The existing booms at both locations are owned by Ontario Hydro and the Power Authority of the State of New York.

In addition to the existing booms, nine additional booms would be placed at various locations in the river between Ogdensburg, N.Y., and Morrisburg, Ontario, to assist in ice cover formation and minimize the flow of ice into the headwater of the Iroquois and Moses-Saunders Dams and to reduce the open water areas which could feed the potential ice jam area at Ogden Island. Within the same reach of the river there are a number of areas, totaling approximately 45,000 feet in length, which have average river flow velocities in excess of 2.6 feet per second.

Appropriate cost sharing with the Canadians would be worked out for the project.

The removal of the floating aids to navigation would require a replacement system of both fixed aids and the establishment of a precise all-weather navigation system.

The winter related problems at the U.S. locks (Eisenhower and Snell) could be handled as follows: to eliminate lock wall icing, either coating the lock walls with a co-polymer coating and removing the ice with portable steam hoses with nozzles, or heated coils would be installed in the lock walls; gate edge icing could be eliminated by heating of the mating edges of the existing miter gates; the installation of gate recess bubbler-flushers; replacing existing gate contact blocks with heated blocks; to avoid the locking of ice through from the upstream lock entrance and the transits delays involved, flow developers along the approach walls would be installed; to keep the locks operational throughout the winter, an extension preventative maintenance and redesign program would be necessary, including heated enclosures for all outside equipment.

During the winter period, icebreaking tugs would be necessary to support Seaway operations, including ice boom and lock maintenance. One of the St. Lawrence Seaway Development Corporation (SLSDC) tugs would need to be modified and a second tug would be purchased new for these purposes.

To accommodate two icebreakers, the U.S. Coast Guard is recommending mooring facility improvements at Cape Vincent, Ogdensburg, and Alexandria Bay, New York.

Canadian Section of the St. Lawrence River

The Canadian Government has to some extent already implemented a number of modifications to its Seaway facilities to provide for limited winter navigation. In addition, a number of other items or areas of improvement may be necessary to allow for winter navigation.

The annual placement of ice booms in Lake St. Francis and the Beauharnois Canal to assure a stable ice cover for power production purposes would require modification with a navigation opening at the points where the booms intersect the navigation channel. Also, ice flushing equipment of the same type, already installed at the St. Lambert and Cote Ste. Catherine Locks, would likely be installed in the Beauharnois Lock.

To stabilize the ice cover in the Cornwall - St. Regis Island reach, a system of four booms is being considered. To further stabilize the ice cover in the Beauharnois Canal, a longitudinal boom system is being considered to prevent ice generated in the navigation channel from overloading the six booms in the canal and the power plant forebay boom.

As in the International section of the river, the Canadian portion replacement of the floating aids with both fixed aids and the establishment of a precise all-weather navigation system is being considered for the all Canadian section from Cornwall, Ontario to Montreal.

There are five Canadian Locks on the St. Lawrence River: Iroquois, Upper and Lower Beauharnois, Cote Ste. Catherine, and St. Lambert. If the Canadian Locks are to operate in the winter, no specific work items have been suggested by the Canadians as necessary at the Iroquois lock. However, at the other four locks, insulating and heating of locks gates to eliminate ice accumulations that would hinder their operation are being considered by the Canadians.

Chemical coating on lock walls to reduce ice adhesion and facilitate ice removal, and heat cables to keep ice from adhering, are being considered. To control floating ice upstream of these four locks, propellers or water jet systems are being considered. Also, to keep the locks operational throughout the winter, an extensive preventative maintenance and redesign program is being considered for all equipment.

To maintain a stable ice cover in Lake St. Louis north of the navigation channel and east of Ile Perrot, artificial islands are being considered which should help to keep the ice cover from shifting into navigation channels.

Similar to the International section of the St. Lawrence River, the Canadian Coast Guard would provide icebreaking and escort assistance in the Canadian portion of the river. To enhance the icebreaking capabilities, an air cushion platform, to be fitted on the bow of the St. Lawrence Seaway Authority tug, LA PRAIRIE, is being considered.

DESIGN

With the extensive amount of actual field experience and design data being collected under the Demonstration Program the design of many recommended measures, such as the air bubblers, ice booms, lock improvements, and aids to navigation will be patterned from concepts investigated or tested under the Demonstration Program.

CONSTRUCTION

With the exception of the construction of the compensating works on the St. Clair and Detroit Rivers (two years), dredging on the St. Marys River (two years), typical construction of a Type B

icebreaker (two years) and associated mooring facilities (one-two years), and construction of the St. Lawrence River ice booms (one year), construction time of other recommended improvements are one year or less. Construction techniques used under the Demonstration Program for the installation of air bubblers and ice booms will provide valuable insight into these installations.

OPERATIONS AND MAINTENANCE

Annual operations and maintenance are required on the following improvements: icebreakers, icebreaking tugs, vessel traffic control systems, ice/weather data collection and dissemination systems, aids to navigation, ice control structures (ice booms), air bubbler systems, locks improvements such as mechanical equipment, floating plant and lock wall de-icing systems, dredging, and compensating works.

The Corps of Engineers management responsibilities associated with the recommended plan would consist of three separate types of activities.

The first would consist of the normal engineering and design, supervision and administration type of work effort for Corps of Engineers construction projects. These activities are expected to be able to be accomplished with existing Corps personnel and/or under contract as needed.

The second aspect of Corps of Engineers involvement would be related to the ADAPTIVE METHOD approach which is part of the plan formulation used for this project. This consists of the implementation of an Environmental Plan of Action (to be accomplished jointly with U.S. Fish and Wildlife Service) which includes the collection of baseline data, operation and monitoring after project

features are constructed, and eventual validation of the project in terms of environmental feasibility. This process would take approximately 15 years and would involve extensive Corps of Engineers management and participation. It is estimated, at this time, that about 25 new personnel spaces would be needed to effectively manage such a program should this project be authorized. This would include Corps of Engineers participation on the recommended U.S-Canadian Joint Board which should be established to superintend the program.

The third associated Corps of Engineers responsibility relates to operation and maintenance type activities involving field personnel. This would include lock operations, ice control devices, air bubbler systems, compensating works, and managing operational plans. These features are part of the plan to provide for an extension of the navigation season and would involve installation, removal, maintenance, and operation activities in varying degrees depending on the item involved. The experience gained during the eight years of the Demonstration Program provides some insight into the level of resources needed; however, since the plan now being recommended goes far beyond the Demonstration Program in scope and magnitude, it is not possible to define, at this time, the impact on operation and maintenance personnel spaces. When site specific plans are developed during the advance engineering and design stage of the project, the specific increases in personnel requirements will be determined.

DIVISION OF PLAN RESPONSIBILITIES

This section describes the responsibilities and cooperation of various Federal and Non-Federal interests in the implementation of the recommended plan of extended season navigation for the Great Lakes and St. Lawrence Seaway.

COST APPORTIONMENT

The President, in his June 1978 water policy message to Congress, proposed several changes in cost sharing for water resources projects to allow the States to participate more actively in project implementation decisions. The changes include cash contributions from benefiting States of five percent of first cost of construction assigned to nonvendible project purposes, such as commercial navigation.

If this policy is applied to the Navigation Season Extension Program, as apparently it will, a contribution would be required from at least the States of Michigan, Ohio, New York, Pennsylvania, Wisconsin, Illinois, Indiana, and Minnesota of an estimated $21,486,000 in cash (5% of $429,730,000, total estimated project first costs assigned to nonvendible project purposes, based on October 1979 price levels). Other items of non-Federal cooperation (including private investments) encompass the standard furnishing of lands, rights and easements, special dock work, off-Federal channel bubblers, off-Federal channel icebreaking, etc., totaling an estimated $11,895,000 as listed in this Final Survey Report currently under public review. Such items of local cooperation would be in addition to the above cash contribution.

In light of the President's proposal, each of the eight Great Lakes States were requested to provide their views on the President's cost sharing policy as it applies to the Draft Navigation Season Extension Survey Report. The requests and responses by the States are included in Appendix C.

The cost of the recommended plan are apportioned by agency and activity as shown on Table 8.

TABLE 8

COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
I. Department of Transportation					
A. U.S. Coast Guard					
1. Icebreaking	159,905	165,543	12,184	9,160	21,344
2. Icebreaker Mooring Improvements (23 sites)	13,619	13,915	1,024	-	1,024
3. Vessel Traffic Control	841	841	63	452	515
4. Ice Data Collection Dissemination System	363	363	27	260	287
5. Aids to Navigation	7,376	7,376	543	5	548
6. Harbors (Navigation Lights & Aids)					
a. Duluth, MN/ Superior, WI	569	569	42	2	44
b. Green Bay, WI	2,071	2,071	152	1	153
c. Alpena, MI	517	517	38	1	39
d. Saginaw, MI	1,035	1,035	76	1	77
e. Toledo, OH	790	790	58	1	59
U.S.C.G. Subtotal 1/	187,086	193,020	14,207	9,883	24,090

1/ In addition to the above, the U.S. Coast Guard would also be responsible for the following activities under their existing agency authority and at no cost to this project: Vessel Speed Control & Enforcement, Safety/Survival Requirements, Vessel Operating and Design Criteria, Search & Rescue Requirements, Oil/Hazardous Substance Contingency Plan, and Vessel Waste Discharge Requirements. They would also assist the U.S. Army Corps of Engineers in implementing the Great Lakes Connecting Channels Operational Plans.

TABLE 8 (CONT.)

COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
I. Department of Transportation (Cont.)					
B. St. Lawrence Seaway Development Corporation					
1. Vessel Traffic Control and Aids to Navigation	1,931	1,931	142	117	259
2. Ice Control Structures 2/	4,998	4,998	368	217	585
3. Lock Modifications	14,141	14,141	1,041	741	1,782
4. Shoreline & Shore Structure Protection	1,957	1,957	144	25	169
5. Island Transportation Assistance	844	883	65	32	97
S.L.S.D.C. Subtotal	23,871	23,910	1,760	1,132	2,892

2/ Assumed to be cost shared 50%-50% by the United States and Canada.

TABLE 8 (CONT.)
COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
II. Department of Defense (U.S. Army Corps of Engineers)					
1. Ice Control Structures In Connecting Channels 3/	2,183	2,183	160	171	331
2. Air Bubler Systems, St. Marys River	1,824	1,824	134	122	256
3. Lock Modifications, St. Marys River	8,633	8,633	635	500	1,135
4. Dredging, St. Marys River	53,310	55,791	4,107	174	4,281
5. Compensating Works, St. Clair & Detroit Rivers	16,444	17,209	1,267	205	1,472
6. Shoreline & Shore Structure Protection	3,024	3,024	222	47	269
7. Island Transportation Assistance	-	-	-	12	12
8. Water Level Monitoring	194	194	14	81	95

3/ Ice control structures on the St. Clair and Detroit Rivers are cost shared 50%-50% by the United States and Canada.

TABLE 8 (CONT.)

COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
9. Harbors (Ice Booms)					
a) Indiana Harbor, IN	1,079	1,079	79	74	153
b) Muskegon Harbor, MI	2,059	2,059	152	141	293
c) Ludington, MI	2,161	2,161	159	149	308
d) Saginaw, MI	2,477	2,477	182	186	368
e) Huron, OH	736	736	54	30	84
f) Lorain, OH	2,890	2,890	213	126	339
g) Cleveland, OH	2,100	2,100	155	89	244
h) Ashtabula, OH	3,050	3,050	225	135	360
i) Conneaut, OH	3,205	3,205	236	140	376
U.S.A., C.O.E. Subtotal 4/	105,369	108,615	7,994	2,382	10,376
III. Department of Commerce (National Oceanic and Atmospheric Administration and National Weather Service)					
Ice and Weather Forecasts	48	48	4	244	248
NOAA-NWS Subtotal	48	48	4	244	248

4/ The U.S. Army Corps of Engineers would also be responsible for the development and implementation of the Great Lakes Connecting Channels Operational Plans at no cost to this project.

TABLE 8 (CONT.)

COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

	Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
IV.	Department of the Interior (U.S. Fish & Wildlife Service)					
	Environmental Plan of Action 5/					
	L. Superior, Huron, Michigan & St. Marys River	51,780	51,780	3,811	-	3,811
	St. Clair & Detroit Rivers and Lake St. Clair & Erie	42,766	42,766	3,148	-	3,148
	L. Ontario & St. Lawrence River	18,810	18,810	1,385	-	1,385
	U.S.F.W.S. Subtotal	113,356	113,356	8,344	-	8,344

5/ Management of Environmental Plan of Action would be a joint responsibility of Fish and Wildlife Service and Corps of Engineers. However, at this time all funds are designated as Department of the Interior (U.S.F.W.S.).

	Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
V.	Non-Federal/Private Interest					
	1. Pilot Access	2,696	2,821	208	113	321

TABLE 8 (CONT.)
COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

	Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
	2. Harbors					
	a) Silver Bay, MN	-	-	-	25	25
	b) Duluth, MN/ Superior, WI	3,691	3,691	271	1,475	1,746
	c) Ashland, WI	194	194	14	581	595
	d) Marquette, MI	194	194	14	130	144
	e) Escanaba, MI	2,398	2,398	176	533	709
	f) Green Bay, WI	-	-	-	75	75
	g) Calumet, IL	1,238	1,238	92	288	380
	h) Muskegon, MI	-	-	-	93	93
	i) Ludington, MI	-	-	-	93	93
	j) Alpena, MI	388	388	29	211	240
	k) Saginaw, MI	-	-	-	93	93
	l) Monroe, MI	553	553	41	232	273
	m) Toledo, OH	-	-	-	75	75
	n) Sandusky, OH	181	181	13	581	594
	o) Huron, OH	362	362	27	211	238
	p) Buffalo, NY	-	-	-	417	417
	Non-Federal/Private Interests Subtotal	11,895	12,020	885	5,226	6,111
VI.	GRAND TOTAL	441,625	450,969	33,194	18,867	52,061

TABLE 8 (CONT.)
COST APPORTIONMENT - RECOMMENDED PLAN ($1,000)

	Agency/Activity	Total First Cost	Total Investment	Annual Interest & Amortization	Annual Operation & Maintenance	Total Annual Cost
I	Department of Transtation					
A.	U.S. Coast Guard Subtotal	187,086	193,020	14,207	9,883	24,090
B.	St. Lawrence Seaway Development Corp. Subtotal	23,871	23,910	1,760	1,132	2,892
II	Department of Defense U.S. Army Corps of Engineers Subtotal	105,369	108,615	7,994	2,382	10,376
III	Department of Commerce National Oceanic and Atmospheric Administration Subtotal	48	48	4	244	248
IV	Department of the Interior U.S. Fish & Wildlife Service 6/ Subtotal	113,356	113,356	8,344	-	8,344
V	Non-Federal/Private Interest Subtotal	11,895	12,020	885	5,226	6,111
VI	GRAND TOTALS	441,625	450,969	33,194	18,867	52,061

6/ See Footnote 5 on DOI - Fish & Wildlife Service detailed breakdown.
NOTE: It should be noted that implementation of many of the activities in this table is contingent upon appropriate Canadian coordination and/or co-participation.

FEDERAL RESPONSIBILITIES

The United States would construct, operate, maintain, and replace, where necessary, the following measures of the recommended plan subject to Congressional authorization and funding.

1. Icebreaking vessels (U.S. Coast Guard). The U.S. Coast Guard has an existing fleet of thirteen vessels engaged in icebreaking activities on the Great Lakes. Many of these vessels currently used for icebreaking will need to be replaced due to their age and condition. The Coast Guard's estimate of additional future icebreaker requirements for the recommended plan is twenty-four icebreaking vessels (4-Type B icebreakers, 20-Type C icebreakers). Icebreaking assistance is required for extended season operations, and the U.S. Coast Guard (and the Canadian Coast Guard) has the only fleet on the Great Lakes to perform this mission (i.e. there is little commercial icebreaking capability available currently on the Great Lakes). Under this program, icebreaking would be available depending upon ice and weather conditions in the lakes, and the commercial navigation channels, such as Whitefish Bay, St. Marys River, Straits of Mackinac, Saginaw Bay and River, the St. Clair and Detroit Rivers, and St. Lawrence River on an "as needed" basis. However, the operations in the extended season program would not preclude their normal support missions.

2. Icebreaker mooring improvements (U.S. Coast Guard). The addition of new icebreakers would necessitate 24 new mooring facilities. The existing two Type B icebreakers have leased mooring facilities at Milwaukee and St. Ignace. The additional four Type B icebreaker mooring facilities would be built at Duluth-Superior, Sault Ste. Marie, Detroit, and Cleveland. Nineteen Type C icebreaking mooring facilities would be required at the following locations:

Sault Ste. Marie, 5 facilities
*St. Ignace, 1 facility
Escanaba, 2 facilities
Port Huron, 1 facility

Detroit, 2 facilities
Toledo, 2 facilities
Cleveland, 1 facility
Buffalo, 1 facility
Oswego, 1 facility
Cape Vincent, 1 facility
Alexandria Bay, 1 facility
Ogdensburg, 1 facility

*One existing facility would also be used at St. Ignace Harbor.

3. Vessel Traffic Control (U.S. Coast Guard). The U.S. Coast Guard has the responsibility for vessel traffic control thoughout the Great Lakes except in the portions of the St. Lawrence River where the St. Lawrence Seaway Development Corporation has responsibility.

4. Aids to Navigation (U.S. Coast Guard). The U.S. Coast Guard has the responsibility, as part of its Congressional mandate, to provide the necessary aids in U.S. waters to delineate commercial navigation shipping lanes and routes, summer and winter.

5. Vessel Speed Control and Enforcement (U.S. Coast Guard). The U.S. Coast Guard has the responsibility for vessel speed control and enforcement throughout the Great Lakes except in the portions of the St. Lawrence River where the St. Lawrence Seaway Development Corporation has responsibility.

6. Safety and Survival Requirements, Vessel Operating and Design Criteria, Search and Rescue Requirements, Oil and Hazardous Substance Contingency Plan, and Vessel Waste Discharge (Non-Human) and (Human)Requirements. The U.S. Coast Guard has the responsibility for the above requirements, criteria, and plan.

7. Vessel Traffic Control and Aids to Navigation (St. Lawrence Seaway Development Corporation). Within its area of jurisdiction on the St. Lawrence River, the St. Lawrence Seaway Development Corporation has the responsibility to do such construction, operation, and maintenance work as is necessary for vessel traffic control and aids to navigation. This responsibility would be shared with the St. Lawrence Seaway Authority of Canada (their Canadian counterpart) under existing agreements.

8. Ice Control Structures (St. Lawrence Seaway Development Corporation). The construction, operation, and maintenance, including the annual placement and removal of the ice booms in the International Section of the St. Lawrence River, would be the responsibility of the St. Lawrence Seaway Development Corporation. This responsibility would be shared with the St. Lawrence Seaway Authority of Canada under appropriate agreements. The reassignment of the ice boom responsibility would require approval from the International Joint Commission and the Corps of Engineers, and possibly the Federal Energy Regulatory Commission.

9. Lock Modifications - St. Lawrence River (St. Lawrence Seaway Development Corporation). The responsibility to construct, operate, and maintain improvements on the two United States locks (Eisenhower and Snell) on the St. Lawrence River would be that of the St. Lawrence Seaway Development Corporation.

10. Ice Control Structures (U.S. Army Corps of Engineers). The construction, operation, and maintenance, including the annual placement and removal of the ice booms on the Great Lakes Connecting Channels, would be the responsibility of the U.S. Army Corps of Engineers.

11. Air Bubbler Systems - St. Marys River (U.S. Army Corps of Engineers). The construction, operation, and maintenance of the bubbler systems at tight turns on the St. Marys River would be the responsibility of the U.S. Army Corps of Engineers.

12. Lock Modifications - Soo Locks, St. Marys River (U.S. Army Corps of Engineers). The lock facilities (U.S. side) are owned by the Federal Government and operated and maintained by the U.S. Army Corps of Engineers, Detroit District. These locks provide the required facilities to enable commercial navigation to transit between Lake Superior and the lower lakes.

13. Dredging - Middle Neebish Channel, St. Marys River (U.S. Army Corps of Engineers). The initial dredging necessary to widen the Middle Neebish Channel for two-way traffic and the maintenance of this dredged channel would be the responsibility of the U.S. Army Corps of Engineers.

14. Compensating Works - St. Clair and Detroit Rivers (U.S. Army Corps of Engineers). The design, construction, operation, and maintenance of river flow compensating works on the St. Clair River at Stag Island and on the Detroit River at Peach Island would be the responsibility of the U.S. Army Corps of Engineers.

15. Great Lakes Connecting Channels Operational Plans and Water Level Monitoring (U.S. Army Corps of Engineers). The development and implementation of operational plans and a water level monitoring program for the connecting channels and the Great Lakes to the extent necessary, particularly for winter navigation, would be the responsibility primarily of the U.S. Army Corps of Engineers.

16. Harbor Ice Booms (U.S. Army Corps of Engineers). The recommended plan of navigation season extension would require that, at nine harbors, ice booms would have to be constructed and maintained, including the annual placement and removal. The responsibility for this activity would be that of the U.S. Army Corps of Engineers.

17. Ice Data Collection and Dissemination System (U.S. Coast Guard). The collection and dissemination of ice data for the Great Lakes and

Connecting Channels in connection with winter navigation would be the responsibility of the U.S. Coast Guard.

18. Environmental Plan of Action (U.S. Army Corps of Engineers and Department of Interior). The development of a plan of action for each of the three system reaches and its implementation has been the joint responsibility of the U.S. Fish and Wildlife Service, Department of the Interior and the U.S. Army Corps of Engineers, Department of Defense.

19. Ice and Weather Forecasts, (Department of Commerce, National Oceanic and Atmospheric Administration - National Weather Service). The development and preparation of ice and weather forecasts in support of an operational winter navigation program would be the joint responsibility of NOAA and the National Weather Service.

20. Shoreline Protection (U.S. Army Corps of Engineers). Mitigative/protective measures for land and structure damages incurred as a result of damages above the ordinary high water mark, if any, would be the responsibility of the U.S. Army Corps of Engineers.

21. Island Transportation Assistance. Island transportation assistance would be provided in the form of lump-sum contributions to non-Federal entities on the St. Marys and St. Lawrence Rivers. The non-Federal entities would operate and maintain the transportation facilities.

NON-FEDERAL RESPONSIBILITIES

The existing projects for the U.S. Great Lakes Connecting Channels and Harbors designates the limits of Federal interest under each of the specific project authorities. These define the general navigation project features and areas which are the responsibility of the Federal Government. Neither local cost sharing nor annual operation and maintenance are required for general navigation project features under Corps Civil Works traditional cost-sharing policy.

The recommended Federal project for extended season navigation is entirely oriented to those existing project areas designated as general navigation areas, namely, lake channels, connecting channels, harbor approach channels, entrance channels, and interior access channels to slip and docking areas. Ice control or winter navigation operational features in these areas have been costed as a Federal cost, as would annual operation and maintenance. However, ice control measures, icebreaking, or any other navigation improvements in private slips, vessel berths and docking areas would be the responsibility of the local and private interests.

In essence, the recommended navigation season extension project is an adaptation of the existing project to a new time frame for operation. Thus, existing agreements and requirements for local cooperation would continue in force and would not be expanded or reduced.

Non-Federal interests would have the following responsibilities to insure winter navigation:

1. Operation and maintenance of the Lime Island airboat on the St. Marys River (coordinate with U.S. Army Corps of Engineers);

2. Operation and maintenance of bubbler-flusher at Sugar Island mainland dock on the St. Marys River (coordinate with U.S. Army Corps of Engineers);

3. Provide funds for operation and maintenance of Government furnished tug with icebreaking capability for island transportation access at Grindstone Island on the St. Lawrence River (coordinate with St. Lawrence Seaway Development Corporation);

4. Purchase, operate, and maintain the necessary pilot access and transfer boats at Cape Vincent, N.Y., and at DeTour and Detroit, Michigan needed for winter operations (coordinate with U.S. Coast Guard);

5. Obtain, construct, operate, and maintain dock and slip bubblers as necessary at the 18 harbors which are to remain operational during the extended season;

6. Purchase or lease icebreaking tugs for operation within the harbors which are to remain operational during the winter; and

7. Provide protective measures for land and structure damages incurred as a result of damages below the ordinary high water mark, if any, and

8. Provide a comprehensive training program for vessel captains to enhance the capabilities of masters operating during the extended navigation season (coordinate with U.S. Coast Guard).

COST SHARING WITH CANADIAN GOVERNMENT

In deriving the United States costs, two assumptions were made: the U.S. would pay 100% of all improvements solely within the U.S. territorial boundaries, and 50% of the total cost of improvements bridging the International boundary. Conversely, it is assumed that Canada would pay for 100% of all improvements solely within its own territorial boundaries as well as 50% of the total cost of improvements bridging the International boundary. The items that are assumed to be cost shared are: ice control structures which bridge the International Boundary on the St. Clair, Detroit, and the St. Lawrence Rivers; also the compensating works on the St. Clair and Detroit Rivers. It should be noted that this U.S./Canada cost split is an initial assumption and is subject to negotiations between the American and Canadian governments.

PLAN IMPLEMENTATION

This Final Feasibility Report preparation is being done by the following schedule.

Activity	Completion Date
Division Engineer's Notice and report submittal to Board of Engineers for Rivers and Harbors for its review and action	31 December 1979

Following the issuance of the North Central Division Engineer's Notice, the report and Final Environmental Impact Statement will, in turn, be reviewed by the Board of Engineers for River and Harbors, Office of the Chief of Engineers (OCE), appropriate Federal agencies, and affected Great Lakes States. Following this review, the report would be forwarded by the Chief of Engineers to the Secretary of the Army for transmittal to Congress after the Office of Management and Budget and Water Resource Council review. Then the report is sent to Congress. If the recommended project is authorized by Congress, funds would be requested through the budgetary process for advanced engineering and design studies, and for subsequent construction and project operation and maintenance.

Because Canadian Government co-participation is required for system-wide year-round navigation, particularly on the Welland Canal and the all-Canadian portion of the St. Lawrence River, the recommended phased implementation of a system-wide program will help to allow for the process of government to government consultation and co-participation. Six alternative phases were evaluated involving year-round extension on the upper four Great Lakes and varying periods of extension and early opening on Lake Ontario and the International Section of the St. Lawrence River. To be done concurrently with the implementation, during the first 10 to 15

years of the advanced engineering and design, construction, and operations phases of the project, would be an Environmental Plan of Action. The plan of action is designed to assure environmental feasibility of navigation season extension, with provisions made for accomplishing any necessary mitigative actions.

The Environmental Plan of Action is an integral part of this approach.

Programmatic Environmental Impact Statement

The Environmental Impact Statement (EIS) accompanying this Survey Report is programmatic in nature. It describes in appropriate detail all currently known environmental impacts that would result from the Extended Season Program. It addresses impacts on a regional scale and provides the program to determine and analyze the environmental data and information for the detailed follow-on EIS's. The EIS also addresses potential, perceived and unforeseen impacts, and the proposed plan for determining which of these might actually occur (i.e., Environmental Plan of Action - EPOA). The EIS, by means of this EPOA, presents the recommended program for assuring that the environment of the Great Lakes system would be protected adequately during development of an Extended Season Program. The recommended program contains a plan, called Adaptive Method, which provides the necessary checks and balances to assure protection of the environment.

Environmental Plan of Action (EPOA)

The EPOA prepared by the U.S. Fish and Wildlife Service and Corps of Engineers has been integrated with the recommended engineering program to extend the navigation season. The Environmental Plan of Action is based on the principle that the Extended Season Program would be modified and, if necessary, a moratorium on program activities would be put in effect if unacceptable environmental impacts are encountered. The EPOA includes

methods for assessing environmental impacts, studies to be conducted, and estimates of study costs.

Assuming Congressional authorization of a Federally assisted Winter Navigation Program, the project would then move into advance engineering and design phases prior to construction and operation, which is briefly described in the following paragraphs.

Post-authorization - Pre-construction Planning

The first steps of the post-authorization process are environmental and engineering of which the Advance Engineering and Design (AE&D) consists of three phases: Phase I General Design Memorandum (GDM), Phase II GDM and Feature Design Memoranda, and preparation of Detailed Plans and Specifications. It is important to note that the post-authorization steps are standard courses of action taken for any authorized civil works project. Project design becomes progressively more detailed and finalized in each phase (or stage) of the process. The Adaptive Method approach will have a significant role in each phase as described below. Associated environmental efforts are discussed as integral parts of those items below.

Phase I GDM. The objective of the Phase I GDM stage -- the reaffirmation or reformulation phase -- is to bridge the gap between the time when a survey report is completed and authorized, and the initiation of detailed engineering and design of the authorized plan. After a project is authorized, changes may occur that could effect the formulation of the authorized project plan, and could change the authorized plan significantly. The Phase I GDM study seeks to identify, assess, and evaluate changes in order that an affirmation of the authorized plan can be made in light of current conditions and criteria, or that a "reformulation" of the authorized plan may be made where these changes are significant.

The Adaptive Method approach during this pre-construction phase includes: implementation of design-specific and systemic baseline

condition development studies as indicated by the EPOA; and secondly, it would provide individual assessments of those activities significantly interacting with the environment, and, as necessary, provide for environmental statements prior to construction/operation of the individual activity based on additional information provided through implementation of the EPOA. This approach will refine the detail and location of impacts identified in the programmatic EIS. Individual environmental statements would be developed as appropriate for each of the project's separable elements, addressing site specific impacts at a level of detail equal to that of the engineering studies. The post-authorization EIS will refine the breadth of impacts identified by the programmatic EIS's as well as information gained through the baseline studies begun in this phase.

The design-specific environmental studies, begun during this phase, are being scheduled to be completed at least twelve months before completion of each Phase I GDM. This would, if necessary, provide for incorporation of any final changes to the authorized plan where appropriate.

Phase II GDM. After approval of each Phase I document, a Phase II General Design Memorandum stage would be implemented. The Phase II document would be primarily a functional design document.

Activities under the Adaptive Method approach in this phase would continue to examine base condition studies conducted in Phase I. While no formal environmental impact report would necessarily be completed other than archaeological reconnaissance as required, design details would be sensitive to specific environmental and social concerns surfaced after the last formal EIS (in Phase I GDM). If significant environmental changes or potential impacts surfaced, a new, revised or supplemental Environmental Impact Statement would be prepared.

After approval of the Phase II General Design Memorandum, specific project feature design memoranda would be prepared for each major element

of the project. Each of the feature design memorandum would, where practicable, include sufficient design data to establish the interrelationship between engineering, the environment and other design aspects of the particular feature. Following this step, detailed plans and specifications would be prepared on the specific project features to enable construction of the project.

Post-authorization - Construction/Operation

During the construction stages of the program, the emphasis of environmental effort would transform from establishing base conditions and analysis to monitoring of "with" project conditions. This monitoring effort would provide a means for determining whether or not the impact predictions were correctly determining that no unacceptable adverse impacts are or would occur with continued operations. Due to the flexible response to environmental concerns as part of the Adaptive Method approach, all actions during construction and operation stages would be sensitive to any adverse project induced changes identified by the monitoring effort.

The monitoring effort would continue in the operational phase and would culminate in the final evaluation or validation report. It is at this validation point that the overall project would be evaluated in light of project induced changes, a validation report prepared, and the report subsequently provided to Congress for their information.

Summary

The Adaptive Method approach would provide the mechanism, in concert with the Environmental Plan of Action and advanced engineering and design, and construction and operation phases of the project, for a sequence of information gathering, impact predictions, and monitoring to further evaluate and assess impact predictions of implementation of an operational winter navigation program. Through the Adaptive Method, construction would

not proceed until adequate environmental assessments and statements have been completed during the pre-construction phase. In addition, the adaptive response mechanism would provide, when and where necessary, for modifying construction/operational activities to reduce or eliminate unacceptable impacts identified by proposed monitoring programs. Results of the Adaptive Method approach would be culminated into a validation report and to be furnished to Congress.

To implement the project, a joint United States-Canadian Board has been recommended to oversee the following functions: engineering/planning; environmental monitoring efforts; construction; and operations to insure that implementation be a coordinated effort.

VIEWS OF FEDERAL INTERESTS

On 23 March 1979, the Draft Final Feasibility Report and Draft Environmental Statement on the Great Lakes and St. Lawrence Seaway Navigation Season Extension Survey Study (and Appendixes) that indicated the findings and tentative conclusions and recommendations were distributed to Congressmen and Federal agencies for review and comment. The report was also distributed to others (see Appendix C).

Responses were received from the following:

U.S. Department of State
U.S. Coast Guard, Department of Transportation
Maritime Administration, U.S. Department of Commerce
St. Lawrence Seaway Development Corporation, Department of Transportation
Federal Energy Regulatory Commission, U.S. Department of Energy
Representative Barber B. Conable, Jr.

In brief, responses contained comments, suggestions, corrections, recommendations, and proposed additions to be considered in the Draft Survey Report. In addition pertinent remarks were made on the overall study and are summarized in the following paragraphs. These letters are included in their entirety in Appendix C.

U.S. Department of State

The Department of State believes that given the International nature of sections of the St. Lawrence River involved and the jurisdiction of the International Joint Commission over the ice booms concerned, all winter navigation season extension activities involving ship movements on the St. Lawrence River should take place only with prior concurrence from the

Government of Canada. In principle, the Government of Canada is interested in the proposed navigation extension program to the extent that program activities: (1) are in accord with Canadian interests, and (2) may affect water levels and flows in boundary waters, or water quality. The Canadians appear to be willing to discuss their views on the program if the United States submits a specific proposal from the Survey Report. It was also noted that proposed winter navigation extension activities having an effect on levels and flows, would require approval of the International Joint Commission according to Article III of the Boundary Waters Treaty of 1909.

U.S. Coast Guard, Department of Transportation

The U.S. Coast Guard made many comments in support of the Survey Study and to improve the accuracy of the report. Additional comments included: (1) a question of the validity of assuming the March 1976 Interim Survey Report recommendations as a base condition, (2) recommendation that both the St. Lawrence Seaway Development Corporation and the Coast Guard be represented on any joint board to oversee extended season navigation, and (3) year-round navigation to all ports has not yet been demonstrated as feasible.

Maritime Administration, U.S. Department of Commerce

Comments on the Survey Study Draft Report from the Maritime Administration included: (1) concern over a statement of the Power Authority of the State of New York regarding potential loss of draft on the St. Lawrence River, and (2) concern over changes in the benefit/cost ratio as the Report is updated.

St. Lawrence Seaway Development Corporation, Department of Transportation

The St. Lawrence Seaway Development Corporation fully concurs in the conclusions of the Survey Report. Addtional comments include: (1) concern over the high cost attributed to improvements on the St. Lawrence River, (2) possible understatement of traffic projections, (3) further analysis and emphasis on the potential positive aspects of the project on levels and flows, (4) need for more documentation and justification for the proposed Environmental Plan of Action, and (5) the proposed joint board needs to accomplish Canadian cooperation and participation under existing International arrangements.

Federal Energy Regulatory Commission

Review of the Survey Report by the Federal Energy Regulatory Commission (FERC) included the following comments: (1) concern over impacts of proposed navigation extension on hydropower projects licensed under the Federal Power Act, (2) further evaluation of impacts on hydroelectric power generation is warranted, (3) other significant economic, technical, and environmental efects -- both within and outside the U.S. -- should be considered, (4) additional information should be included on actual power generation losses and gains, and (5) the FERC should be specified as a full member of a joint board.

Representative Barber B. Conable, Jr.

U.S. Representative Conable expressed his strong opposition to the extension of the navigation season on Lake Ontario and the St. Lawrence River, based on the following: (1) the validity of the benefit/cost analysis, (2) potential shore erosion and shore structure damage, (3) potential of an oil spill, and (4) effects on hydroelectric facilities.

Requests for additional information or clarification on the Draft Survey Report were received from the following Congressmen (listed chronologically):

Representative John M. Murphy
Representative David H. Bonior
Senator Carl Levin
Representative Robert W. Davis
Representative Barber B. Conable, Jr.
Representative Guy Vander Jagt
Representative Carl D. Pursell
Senator William Proxmire
Senator Henry L. Bellman
Senator David L. Boren

Letters of response and information were provided to these Congressmen, answering their specific inquiries.

VIEWS OF STATE INTERESTS

On 23 March 1979, the Draft Survey Report and Draft Environmental Statement on the Great Lakes and St. Lawrence Seaway Navigation Season Extension Survey Study (and Appendixes) were distributed to the Governors of the eight directly concerned Great Lakes States.

Responses were received from five of the eight states:

Honorable William G. Milliken, Governor of Michigan
Honorable Hugh L. Carey, Governor of New York
Honorable James R. Thompson, Governor of Illinois
Honorable Lee Sherman Dreyfus, Governor of Wisonsin
Mr. Clifford L. Jones, Department of Environmental Resources, for Honorable Dick Thornburgh, Governor of Pennsylvania

The complete correspondence from these Governors is included in Appendix C. A synopsis of each response is given below:

State of Michigan, Office of the Governor

The Governor cannot support a year-round season without first completing environmental, economic and engineering studies necessary to assure the soundness of such a program. In addition, without an adequate determination of the project benefits that would accrue to Michigan as a result of a possible navigation cost sharing investment it is not possible to speculate on what future position the State may take.

State of New York, Office of the Governor

The Governor states his opposition to the navigation season extension program based on concerns over potential power loss, flood damage, adverse environmental impacts, and the validity of the economic analysis.

State of Illinois, Office of the Governor

The Governor's comments address state cost-sharing as it relates to the proposed navigation season extension program. The Governor is concerned that legislation clearly delineate States that will be involved in planning and in establishing priorities for water projects. No present legislation requires state cost-sharing for the proposed navigation extension program. Multi-State or International navigation projects should not require State financial participation.

State of Wisconsin, Office of the Governor

The State of Wisconsin supports the concept of efficient utilization of Great Lakes shipping opportunities and the resulting local economic benefits and energy savings. Although the Governor supports the concept of navigation extension, he is unable to endorse project authorization at this time because of the abundance of questions that remain unanswered about the impacts (water quality and economic) of the project on Wisconsin. The Governor states that a 2-phase "operation" (the first being detailed feasibility investigations) would be a more reasonable course of action.

Department of Environmental Resources for State of Pennsylvania, Office of the Governor

The Governor concludes that costs of needed improvements for the navigation extension program's operation in Pennsylvania are classified under the conventional costs of non-Federal cooperation. Due to the complexity of determining program benefits and circumstances of "tight budgets," the Governor cannot endorse the proposed cost-sharing policy.

Two independent reports were prepared at the request of the Governors of Michigan and New York which address the methodology and conclusions of certain aspects of the survey study. These reports are:

(1) The Great Lakes Basin Commission's <u>Economic Review of Winter Navigation (February 1979)</u>

(2) The New York State Department of Transportation's <u>Season [illegible]ion on the Great Lakes/St. Lawrence Seaway: A Critique of the Recomme[illegible] [illegible]lan of the U.S. Army Corps of Engineers (July 1979)</u>.

These reports raised concerns regarding possible alternatives to season extension that would increase the capacity of the system; the discount rate used; the use of regional multipliers; benefit-cost calculation, equity, and distribution; and general cargo movement on the St. Lawrence River. All of these questions were considered in preparation of this final report and valid issues were incorporated in the form of revisions where possible, consistent with existing regulations and laws concerning benefit analysis. Further discussion on these two reports is presented in Appendix D.

CONCLUSIONS

The study conclusions center on economic and job opportunities and fuel or energy efficiencies, are encouraged by proven and feasible engineering means, are tempered by environmental and social considerations and have been influenced by the public via meetings, labor-carriers-agency views, and Corps of Engineer introspection.

Following appropriate systemic and site specific environmental investigations and careful coordination with geographically-oriented engineering studies (both reaffirmation and reformulation, as appropriate) so as to ensure maximum economy of effort and environmentally compatible individual projects; design, construction and operation should be undertaken to provide the means to eventually extend the navigation season on the upper lakes to year-round and up to 10 months on Lake Ontario and the International Section of the St. Lawrence River.

The ultimate blueprint of year-round navigation on the upper lakes and 10 months navigation on Lake Ontario and St. Lawrence River would be accomplished in geographically and time-based incremental phases so as to move step-by-step as navigation traffic fulfills milestone projections and confirms the economic benefit anticipation and environmental predictions. Where appropriate and necessary, these steps would also be taken in cooperation and co-participation with the Canadians. Formal agreement with the Government of Canada is required for virtually any extensions on the system beyond the upper three lakes.

The following concept of effort assumes the Nation has implemented measures as recommended in the November 1977 Chief of Engineers Report to extend the season on the upper lakes to late January plus or minus some period of time depending on the severity of the winter.

On the upper three Great Lakes (Michigan, Superior and Huron) season extension to attain the potential benefits can take place up to year-round as soon as environmental feasibility is confirmed, and the engineering works and social mitigative measures are accomplished.

The season on Lake Erie should be extended, when practicable, to synergistically integrate pre-extension traffic which sailed continually during the winter when ice conditions allowed, upper three lakes extension bulk traffic, and seaway extension traffic as that section of the system comes on line. As traffic demands and ice navigation technology is perfected, it is envisioned that the season could be extended up to year-round. This would, of course, follow appropriate environmental and engineering effort to include the ice control structures and currently anticipated requirement for compensating works to maintain historical levels and flows in the associated rivers and lakes.

On Lake Ontario and the St. Lawrence River the rationale for the phasing begins with the current closedown period, 15 December to 1 April, and expands the season from both ends based on experience, informal Canadian plans, hydraulic capability, avoidance of levels and flows problems, economic benefit forecasts, shipping needs, and environmental sensitivity.

Based on experience and informal Canadian plans, the first extension phase on Lake Ontario and the St. Lawrence River would be from 15 December to approximately 31 December. Sailings into late December have occurred over several of the past years to clear ships from the system and this extension should be readily attainable.

The next likely extension period is to begin the season earlier, approximately 20 March as spring is on its way and, on the average, the River is again up to Low Water Datum (even without any hydraulic flow improvements due to more and/or better ice control structures). This extension also conforms to informal Canadian plans.

To move from the 9 1/2 months, the current conceptual maximum visualized by the Canadians, to 10 months suggested by some as the minimum necessary for overseas shippers to fully commit resources to the Great Lakes-Seaway System, would require hydraulic flow improvements which are feasible according to ice control structures studies--but to be checked out by actual physical tests--to overcome flows below Low Water Datum with resulting light-loading disbenefits. This would continue to be without dredging. This increment would extend the season one week longer to approximately 7 January, when ice formation normally begins, and start the season early, around 7 March.

Since the ice formation period to stabilize winter flows spans from approximately 7 January for 30 days, another month might conceivably be added some time in the distant future starting the season around 7 February. Such a season would maximize net benefits assuming a minimum level of dredging is required. Dredging may or may not be required depending on the efficiency of the ice control structures (previously mentioned) to improve the hydraulic capacity of the River. However, based on the potential of major dredging--objectionable to the Fish and Wildlife Service, State of New York and local residents--it is felt imprudent, at this time, to include the 11-month proposal in the recommendations. Since this would be many years and even decades down the time stream, such an idea can be evaluated at that time. The longer winter closedown period with a 10-month season will allow for a longer lock maintenance period. (The 11-month season is also beyond the scope of any short to mid-term Canadian conceptualization.)

All of the preceding are contingent upon the accomplishment of the associated Environmental Plan of Action to affirm and confirm environmental feasibility. As indicated, this Environmental Plan of Action would have to be closely integrated and coordinated with the early-on engineering efforts to arrive at the correct or best decision with regard to each part of any geographical phase of the extension.

Is is envisioned that all of the foregoing effort would be superintended--over and above that allowed by current agreements between the U.S. and Canadian Governments, including the Seaway entities--by a Joint U.S.-Canadian Board that would have representatives (on the U.S. side) of an environmentally-oriented agency, navigation/transportation agency, a construction agency, and the key affected State.

The plan described is believed to be the best way to secure significant benefits to the Nation and Great Lakes Region, maintain environmental quality, and consider and mitigate those interests along the affected shores. Additionally, there would be significant national defense-oriented, but uncounted, benefits.

These conclusions with respect to the St. Lawrence River (and Lake Ontario) are contrary to the desires of the State of New York and the U.S. Department of the Interior, especially the Fish and Wildlife Service, whose Region 5 supports the State of New York. The conclusions are reached, however, in light of the overall benefit to the Nation and the other States bordering on and using the Great Lakes. New York's and the Fish and Wildlife's concerns have been addressed as completely as possible in this report and as part of the recommendations. It is in that light, that the recommendations in the following section are made.

Specific conclusions of this study are as follows:

1. Studies and the Demonstration Program have shown that season extension up to year-round on the upper four Great Lakes (Superior, Michigan, Huron, and Erie) and the connecting channels (St. Marys, St. Clair, and Detroit Rivers) is engineeringly and economically feasible.

2. Studies have further shown that season extension on Lake Ontario and the International Section of the St. Lawrence River is engineeringly and economically feasible up to an 11-month season.

3. Should a navigation season extension be implemented, it would be phased, as discussed above, both geographically and over time. Evidence, to date, indicates that season extension can be accomplished in an environmentally acceptable manner. However, it would be necessary to utilize a concept (referred to as an Adaptive Method) to insure environmental investigations and considerations are appropriately integrated with engineering planning, design, and construction activities and to provide necessary checks and balances to assure protection of the environment. This would include the implementation of an Environmental Plan of Action to gather down data, analyze, suggest or recommend engineering changes, mitigation, etc. then to confirm assumptions, observations and conclusions reached with respect to environmental feasibility.

4. Mitigative measures have been identified to preclude disruption of island transportation in the St. Marys and St. Lawrence Rivers, however, to assure that impacts of extended season navigation

are minimal on Drummond Island on the St. Marys River, and Harsons Island on the St. Clair River, further monitoring of these areas would be carried on and mitigative action taken, if needed.

5. Existing ice booms in the St. Lawrence would need to be modified to permit winter vessel transits. Vessel transit tests would also be required to fully evaluate alternatives. These measures would need to be coordinated with the Government of Canada.

6. System benefits to costs are favorable to the Nation. Benefits would be realized in the areas of transportation efficiency, stockpiling savings, better fleet utilization, and more effective use of the Great Lakes Waterway. As the Great Lakes fleet has been substantially upgraded in the last ten years (with this trend continuing), the more complete utilization or recent fleet improvements is of even greater necessity.

7. Studies have indicated that energy consumption from an extended navigation season compares favorably to energy consumption of alternate transportation modes.

8. Studies to date have indicated that, should an extended navigation season be implemented, the hydraulic regime of the system could be maintained or improved through mitigative action.

9. Studies to date have indicated that navigation season extension would result in an increase in regional income and employment for ports and their surrounding areas within the Great Lakes Region.

10. The necessary steps to achieve formal Canadian coordination should begin upon authorization of this project by the Congress.

In addition the following paragraphs state the conclusions of this report concerning the questions on liability resulting from the implementation of the recommended winter navigation program. The question of liability is probably the most important concern of riparians, especially those owning property along the connecting channels.

1. The Power Authority of the State of New York (PASNY) would be liable for damages associated with failure of the St. Lawrence River ice control system, even if the failure were due to modification of the ice booms to permit the transit of vessels. PASNY is further liable for riparian damage caused by failure of the booms under the laws of the State of New York whether or not the booms are modified or altered to permit navigation.

2. The liability of the Federal Government resulting from winter navigation activities, other than modification of the ice booms, is limited to damages above the high water mark where there is a taking of property or where there is damage caused by an act of operational negligence as opposed to a discretionary act.

3. The rationale behind the inability of the Federal Government to pay for damages below the ordinary high water mark results from the dominant servitude of the Federal Government which may be exercised in favor of navigation. When the rights of the Federal Government are exercised with respect to the dominant servitude, there is no taking of private property and the riparian owner is not entitled to compensation. This is a long standing legal principle and the authority of Congress is necessary before the Government may deviate from this position and pay for claims of damage below the high water mark.

4. With respect to claims above the high water mark not cognizable under the various acts which are more fully discussed in the Legal Appendix (e.g., Federal Tort Claims Act), the same type of Congressional action would be necessary.

In summary, the Federal Government has waived sovereign immunity in only a limited number of cases. Damages which may accrue as a result of the winter navigation program generally fall in those areas in which sovereign immunity has not been waived and action by the Congress in passing new legislation would be necessary to change the law in this area. This report has discussed several types of programs which could be implemented to compensate for damages should the Congress pass enabling legislation.

RECOMMENDATIONS

It is recommended that the plan described in this report (i.e., 12-month navigation on the upper three Great Lakes and their connecting channels, up to 12-month navigation on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to 10-month navigation on Lake Ontario and the International Section of the St. Lawrence River to be accomplished concurrently with an Environmental Plan of Action) be authorized for construction as a Federal project for navigation purposes, with such modifications as in the discretion of the Chief of Engineers may be advisable; at a first cost[1/] to the United States presently estimated at $441,625,000, annual operation, maintenance and replacement costs presently estimated at $52,061,000. The locations of the measures in the recommended plan are shown in Figure 8.

It is further recommended that the work be accomplished in separable increments as determined feasible by the Chief of Engineers.

Implementation of the above recommendation would require provision of structural and nonstructural measures as defined in this report. Those measures directly related to the responsibility of the U.S. Army Corps of Engineers are:

a. Ice Control Structures in Great Lakes Harbors and Connecting Channels;

b. Air Bubbler Systems in Great Lakes Harbors and Connecting Channels;

c. Lock Modifications at Sault Ste. Marie, Michigan;

d. Dredging in St. Marys River;

e. Compensating Works in St. Clair River;

f. Shoreline and Shore Structure Protection in the St. Marys, St. Clair and Detroit Rivers;

1/ First Cost: The total project construction cost including costs of lands, relocations, engineering, design, administration, and supervision. See Appendix L for definitions of terms.

g. Island Transportation Assistance in the St. Marys River;[1]

h. Water Level Monitoring in the St. Marys, St. Clair, and Detroit Rivers;

i. Great Lakes Connecting Channels Operational Plans; and

j. Environmental Plan of Action (joint responsibility with U.S. Fish and Wildlife Service).

Measures directly related to the responsibility of other Federal agencies, non-Federal agencies, and private interests such as implementing measures to safeguard shipping and protect crews, overcome other ice navigation difficulties, initiate coordination with Canada, initiate harbor improvements, etc. are displayed in Table 8 of this report.

In addition, to provide the institutional framework to oversee the implementation of these recommendations and to provide a final validation report, the U.S. Section of an eventual Joint Board should be created. The agencies would include Department of the Army, Department of the Interior, Department of Transportation, and a State Representative. This U.S. Section would be dis-established once the objectives of the Season Extension Program have been realized, the operations satisfactorily tested and implemented, and the validation report submitted to Congress.

[1] Includes lump-sum contribution of $133,000 to a non-Federal entity to operate and maintain the mainland dock bubbler-flusher at Sugar Island in the St. Marys River, and a lump-sump contribution of $21,000 to a non-Federal entity to operate and maintain an airboat at Lime Island in the St. Marys River.

MELVYN D. REMUS
Colonel, Corps of Engineers
District Engineer


CANADA
UNITED STATES
MINNESOTA
TACONITE
1 SILVER BAY
TWO HARBORS
2 DULUTH
SUPERIOR
3 ASHLAND
LAKE SUPERIOR
PRESQUE ISLE 4
MARQUETTE
MICHIGAN
WHITEFISH BAY - A
ST. MARYS RIVER - B
SAULT STE MARIE LOCKS & HARBOR - C
SUGAR NEEBISH LIME ISLANDS - D
DETOUR PASSAGE - E
DRUMMOND ISLAND
F - ST. IGNACE
STRAITS OF MACKINAC
5 ESCANABA
-N-
6 GREEN BAY
11 ALPENA
LAKE HURON
LAKE MICHIGAN
LUDINGTON 10
PORT WASHINGTON
WISCONSIN
MILWAUKEE
MUSKEGON 9
12 SAGINAW
L - GRINDS
WELLAND CANAL CANADIAN
LAKE
G - PORT HURON
H - ST. CLAIR RIVER
LAKE ST. CLAIR
I - DETROIT
J - DETROIT RIVER
7 CALUMET
ILLINOIS
8 INDIANA
GARY
BURNS WATERWAY
13 MONROE
14 TOLEDO
LAKE ERIE
PENNSYLVANIA
CONNEAUT 20
ASHTABULA 19
15 SANDUSKY
16 HURON
17 LORAIN
18 CLEVELAND
INDIANA
OHIO
UNITED

HARBOR MEASURES

1. ICEBREAKING TUG
2. AIDS TO NAVIGATION
   BUBBLERS (23,000')
   HIGH POWER ICEBREAKING TUG
   CHANNEL CLEARING CRAFT
   ICEBREAKER MOORING TYPE B
3. BUBBLERS (1,000')
   HIGH POWER ICEBREAKING TUG
4. BUBBLERS (1,000')
   ICEBREAKING TUG
5. BUBBLERS (17,000')
   ICEBREAKING TUG
   ICEBREAKER MOORING TYPE C
6. NAVIGATION LIGHTS (6)
   ICEBREAKING TUG
7. BUBBLERS (8,000')
8. ICE BOOM (4,000')
9. ICE BOOM (7,600')
   ICEBREAKING TUG
10. ICE BOOM (3,000')
    ICEBREAKING TUG
11. NAVIGATION LIGHT
    BUBBLERS (2,000')
12. NAVIGATION LIGHTS (2)
    ICE BOOM (10,000')
    ICEBREAKING TUG
13. BUBBLERS (4,000')
    ICEBREAKING TUG
14. AID TO NAVIGATION
    ICEBREAKING TUG
    ICEBREAKER MOORING TYPE C (2)
15. BUBBLERS (1,000')
    HIGH POWER ICEBREAKING TUG
16. BUBBLERS (1,000')
    ICE BOOM (1,600')
    ICEBREAKING TUG
17. ICE BOOM (6,800')
18. ICE BOOM (4,800')
    ICEBREAKER MOORING TYPE C
    ICEBREAKER MOORING TYPE B
19. ICE BOOM (7,200')
20. ICE BOOM (7,600')
21. HIGH POWER ICEBREAKING TUG
    ICEBREAKER MOORING TYPE C
22. ICEBREAKER MOORING TYPE C

SYSTEM WIDE MEASURES

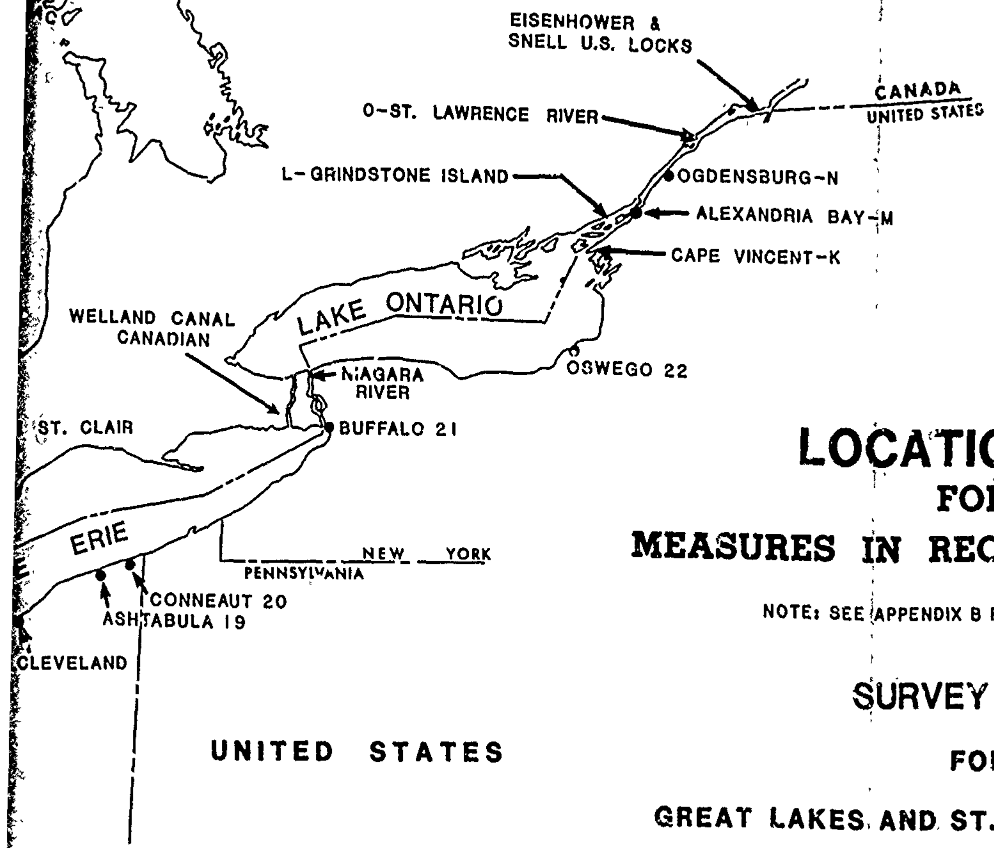
ICEBREAKERS TYPE B (4)
ICEBREAKERS TYPE C (20)
AIDS TO NAVIGATION
ENVIRONMENTAL PLAN OF ACTION

UPPER FOUR LAKES-ONLY
VESSEL TRAFFIC CONTROL
ICE DATA COLLECTION/DISSEMINATION
WATER LEVEL MONITORING

UPPER THREE LAKES-ONLY
ICE AND WEATHER FORECAST

CHANNELS AND LAKES MEASURES

A. AIR BUBBLER SYSTEM
B. SHORELINE PROTECTION AND SHORE STRUCTURE COMPENSATION.
C. LOCK MODIFICATIONS U.S. LOCKS
   ICE BOOM
   ICE STABILIZATION ISLANDS (2)
   ICEBREAKER MOORING TYPE B
   ICEBREAKER MOORINGS TYPE C (5)
D. AIR BUBBLER SYSTEMS (5)
   DREDGING
   ISLAND TRANSPORTATION
E. PILOT ACCESS
F. ICEBREAKER MOORING TYPE C
G. ICEBREAKER MOORING TYPE C
H. ICE BOOM (4,400')
   COMPENSATION WORKS
   SHORELINE PROTECTION AND SHORE STRUCTURE COMPENSATION
I. PILOT ACCESS
   ICEBREAKER MOORING TYPE B
   ICEBREAKER MOORINGS TYPE C (2)
J. ICE BOOM (6,000')
   COMPENSATION WORKS
   SHORELINE PROTECTION
K. PILOT ACCESS
   ICEBREAKER MOORING TYPE C
L. ISLAND TRANSPORTATION
M. ICEBREAKER MOORING TYPE C
N. ICEBREAKER MOORING TYPE C
O ICE BOOMS (11 EACH)
  LOCK MODIFICATIONS
  EISENHOWER AND SNELL
  SHORELINE PROTECTION AND SHORE
  STRUCTURE COMPENSATION



LOCATION MAP FOR MEASURES IN RECOMMENDED PLAN

NOTE: SEE APPENDIX B FOR PROJECT DETAILS

SURVEY STUDY FOR GREAT LAKES AND ST. LAWRENCE SEAWAY NAVIGATION SEASON EXTENSION

2

FIGURE 8

NCDPD-PF (August 1979) 1st Ind
SUBJECT: Final Survey Report for Great Lakes and St. Lawrence Seaway Navigation Season Extension

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 31 December 1979

TO: Chief of Engineers

I concur in the analysis and recommendations of the District Engineer that the plan for 12-month navigation on the upper three Great Lakes and their connecting channels, up to 12-month navigation on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to 10-month navigation on Lake Ontario and the St. Lawrence River be authorized. All project planning should be accomplished concurrently with the Environmental Plan of Action requiring authorization as a part of the recommended Federal navigation project.

The EIS accompanying this Survey Report is programmatic in accordance with the Council on Environmental Quality regulations (43 FR 55978-56007 29 November 1978, Sec. 1500.4 and 1502.4). It describes all currently known environmental impacts that would result from the Extended Season Program, addressing impacts on a regional scale. The EIS, by means of the Adaptive Method, presents an environmental program that would greatly increase our knowledge of the Great Lakes environment and would protect the environment during development and operation of the extended season system. The Programmatic EIS is adequate and in compliance with CEQ regulations.

It is necessary for navigation to stop during the ice formation periods on the St. Lawrence River to allow an ice cover to stabilize in order to prevent ice jams and maintain adequate river flows throughout the winter. The ice cover formation periods normally occur at different times in two critical areas; first, downstream in the Soulanges Reach of the Canadian section, then, about two weeks later, in the International Rapids Section. The precise closing dates and agreement on other related matters of mutual concern will require Canadian co-participation. Therefore, I recommend that a joint United States-Canadian Board be established. I foresee a 2-year engineering test of ice stabilization booms in the St. Lawrence River conducted by the recommended Joint Board during the post-authorization period.

I further recommend that Congress enact legislation, providing the Secretary of the Army, acting through the Chief of Engineers, discretionary authority to study, design and implement protection or remedial measures to alleviate shoreline erosion damage in the connecting channels directly caused by vessel operations in an authorized extended navigation

season. I note that the report identifies certain Federal costs for protective works at some locations in the connecting channels. The exact locations of those properties most susceptible to potential ice damage and the associated costs will be determined during future project planning. Exercise of such a discretionary authority would be predicated upon economic, engineering, and environmental feasibility as well as social well-being considerations. Enactment of such legislation would provide a legal authority for providing relief to riparian interests who are presently barred from recovery under the doctrine of navigation servitude.

The recommended plan has evolved through an iterative process in which numerous alternatives and navigation scenarios have been examined and screened. The total investment cost is estimated at $451 million in the United States of which $442 million is Federal. The plan provides over $205 million in average annual U.S. benefits over the 50-year investment horizon of the project compared with $52 million in average annual U.S. costs including operations and maintenance. The resulting 4.0 benefit-to-cost ratio reflects the positive influence that navigation season extension on the Great Lakes and St. Lawrence Seaway will provide to the Nation.

I recommend construction authorization for this project in accordance with the President's proposed cost-sharing policy.

Richard L. Harris
RICHARD L. HARRIS
Major General, USA
Division Engineer

FINAL SURVEY STUDY for GREAT LAKES and ST. LAWRENCE SEAWAY NAVIGATION SEASON EXTENSION

FINAL ENVIRONMENTAL IMPACT STATEMENT

AUGUST 1979

U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT, MICHIGAN

FINAL

ENVIRONMENTAL STATEMENT

SURVEY STUDY

FOR

GREAT LAKES-ST. LAWRENCE SEAWAY

NAVIGATION SEASON EXTENSION

LIST OF PREPARERS

The following people were primarily responsible for preparing this Environment Impact Statement from the U.S. Army Engineer District, Detroit.

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Lloyd Fanter*	Wildlife	3 years environmental impact preparation, 2 years wildlife research.	Wildlife Biologist
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*Preliminary Draft and Draft Environmental Impact Statement only.

AUGUST 1979
ENVIRONMENTAL IMPACT STATEMENT

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INTRODUCTION

This environmental statement has been rewritten to conform to new Council on Environmental Quality (CEQ) guidelines and Corps of Engineers regulations developed in accordance with those guidelines. The new guidelines have required major changes in the format of the document, such that it no longer bears a close resemblance to the draft. Further, the new guidelines require a reduction in size of the document (recommended to be about 50 pages) which forces a further deletion of detail from the statement. Details are presented in Appendix F, and that portion of the report should be reviewed for that definitive information considered necessary or desirable.

Also, under the new guidelines, the comment and response portion, normally in the EIS, has been placed in a separate appendix, (Appendix C) along with the Corps of Engineers responses to the recommendations made by the U.S. Fish and Wildlife Service in its Coordination Act Report.

I. SUMMARY

Major Conclusions and Findings

1.01 Consideration is given in this report to the environmental feasibility of the means for extending the navigation season on the Great Lakes-St. Lawrence Seaway into the winter months, beyond the usual eight and one-half month season, to as much as year-round. The scope of this study includes U.S. harbors, the five Great Lakes and their connecting channels and shorelines, and the International Section of the St. Lawrence River.

1.02 The Environmental Impact Statement (EIS) is programmatic in nature in that it addresses the impacts of the entire Navigation Season Program on a regional scale while describing the process for determining details of site-specific and system-wide impacts at appropriate times following authorization of the Program as planning continues, engineering and design are accomplished, and before, during, and after construction and operation activities take place. The programmatic EIS and subsequent environmental documents would exemplify the "tiering concept" as stated by the Council on Environmental Quality-National Environmental Policy Act, Implementation of Procedural Provisions; Final Regulation (Federal Register, Vol. 43, No. 230, 55978-56007). "Tiering" refers to the "coverage of general matters in broader EIS's (such as National program or policy statements) with subsequent, more narrow statements or environmental analyses (such as regional or basin-wide program statements or, ultimately, site-specific statements) incorporating, by reference, the general discussions and concentrating solely on the issues specific to the statement subsequently prepared."

1.03 Separate EIS's would be developed, as appropriate, during the Advanced Engineering and Design stage (post authorization) which would reference this programmatic statement to identify and discuss any significant changes in impacts or new impacts of site specific actions in well-defined locations within the system. These EIS's would accompany planning and design documents developed prior to construction or operation.

1.04 Two alternative plans to that selected are being considered which represent realistic ways of using the water resources of the Great Lakes region for navigation during the winter months in an acceptable manner. These alternatives meet planning objectives and criteria, optimize national economic development (NED), and provide for no change in environmental quality (EQ). Environmental considerations of these two alternative plans are summarized as follows:

1.05 No Further Action Plan Alternative - Extended Navigation Season to 31 January ± 2 weeks. This alternative provides for structural and nonstructural operational measures to support a navigation season on the

upper four Great Lakes and their connecting channels. Operational measures include icebreaking assistance, lock operations (Sault Ste. Marie, Michigan), operation of the Lime Island airboat (St. Marys River), operation of the bubbler-flusher system, Sugar Island Ferry (St. Marys River), and the St. Marys River ice boom at the Little Rapids Cut. Mitigation for shore erosion and shore structure damage from winter navigation would be provided if this damage is above the ordinary high water mark. An environmental appraisal program would be conducted concurrently with implementation of the recommended operational measures during the first three years of the project to validate the assessment of impacts.

1.06 Extended Navigation Season Alternative (NED Plan). This plan provides for various activities and improvements which are considered necessary to achieve year-round navigation on the upper four Great Lakes and connecting channels, and eleven-month navigation through the Lake Erie-Lake Ontario-St. Lawrence River portion of the system. The survey study report presents a description of phased implementation of these improvements throughout the Great Lakes-St. Lawrence River portions of the system. On the upper lakes, many of the improvements to navigation were implemented or tested during the Demonstration Program of the Extended Season study. These measures were analyzed, assessed and reviewed in Environmental Impact Statements prepared annually throughout the eight years of the Demonstration Program and were generally found to be environmentally acceptable. Demonstrations were not completed on the Lake Ontario-St. Lawrence Seaway portion of the system following the recommendations of the Division Engineer of the North Central Division in 1978. It was recommended that additional information be obtained on levels and flows, co-participation of the Canadian government and an integrated and coordinated environmental monitoring plan. However, authorization for the Demonstration Program ended in September 1979.

1.07 This plan (NED) would not provide for the system-wide ecosystem studies or the level of monitoring or validation reports proposed for the selected plan. Opportunities to provide environmental improvement such as in oil spill clean-up ability, would be foregone. The usual environmental statements for site specific activities would be required, the same as with the selected plan.

1.08 Extended Navigation Season Alternative (EQ Oriented). This plan, the recommended plan, provides for twelve-month navigation on the upper three Great Lakes, up to twelve-month navigation on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to ten-month navigation on Lake Ontario and the International portion of the St. Lawrence River. All measures of the NED Plan are included except dredging on the St. Lawrence River which could be eliminated by shortening the navigation season to ten months. The plan also recommends implementation of the EPOA and Adaptive Assessment technique for properly evaluating and validating environmental impacts of a system-wide extended winter navigation project. Through this approach, contributions could be made to the preservation, maintenance,

restoration or enhancement of the environmental quality of the Great Lakes/St. Lawrence Seaway System. The intent is to provide for enhancement as opportunities are identified in post authorization studies under the Adaptive Method.

1.09 This programmatic statement identifies currently known environmental impacts of project measures proposed, on a site specific and regional scale. An Environmental Plan of Action (EPOA) recommends follow-on studies and an Adaptive Assessment Methodology as part of the proposed plan. This approach to resolving issues would assure the maintenance of environmental quality after establishing the environmental baseline, while providing for phased economic growth of the region. This approach also provides a mechanism for a sequence of information gathering, impact analysis and prediction, construction, operation, and monitoring to verify predictions. The Adaptive Method also includes provisions to reduce or eliminate predicted or discovered (unpredicted) adverse impacts.

Areas of Controversy

1.10 The following are issues which were subjects of major disagreement among public interests during the course of the study, summaries of conclusions that were reached are included.

1.11 Disruption to island transportation especially on the St. Marys, St. Clair, and St. Lawrence Rivers. An airboat was provided and is proposed for mitigating the loss of over-ice transportation for residents of Lime Island. Interruption to ferry service for Sugar Island due to channel ice from winter navigation would be mitigated by installation of ice booms and bubbler flushers. Assistance during the Demonstration Program provided design-improvement to the ferry vessel. Further study could show a need for ice booms at the head of Harsens Island and an icebreaking tug is proposed for transportation of Grindstone Island residents.

1.12 Shore erosion and shore structure damage. Mitigation would be provided through vessel speed restrictions and shore protection measures such as riprap and protection of structures by offshore piling. Riprap would protect against erosion from all sources, natural and traditional-season vessel-induced, as well as extended season vessel-induced. Studies to identify project-related adverse effects would be continued under the Environmental Plan of Action, using the Adaptive Method.

1.13 Dredging on the St. Lawrence River. Selection of the 10-month navigation plan on the St. Lawrence, with twelve-month navigation on the upper three Great Lakes, up to twelve-month navigation on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to ten-month navigation on Lake Ontario and the International portion of the St. Lawrence River throughout the remainder of the system, would provide a no dredging alternative on the St. Lawrence River.

1.14 Phased accomplishment of environmental baseline studies and project authorization. Of major concern is the mechanism in the plan which would provide a "go", "no-go" type of decision-making action in the context of findings of environmental studies. Two-phased authorization being recommended by the EPA, Department of the Interior, Governor of Michigan, Governor of Wisconsin, and Governor of New York. This methodology would provide for the same "go", "no-go" funding decisions by Congress as the more customary single phased authorization, but would also require separately authorized engineering (and environmental) studies and construction. Authorization of a legislative Phase I study is a Congressional prerogative. The plan, as currently recommended, provides a mechanism, the Adaptive Assessment Method, which would be capable of identifying adverse impacts in a timely manner and providing for their elimination or mitigation.

1.15 Canadian Co-participation. Informal coordination was accomplished between United States and Canada for the Demonstration Program, now concluded. Upon signal from Congress via the authorization of some additional season extension legislation, a request would be made to the State Department for formal response by the Canadian Government on the recommended plan of improvement. If the plan is authorized by the Congress, co-participation discussions could be initiated.

1.16 Oil and Hazardous Spills. Studies have been completed and more would be undertaken to improve contingency planning clean up capability, technology, vessel design for containment and safe navigation, and identification of acceptable mitigation measures. Investigations being done by the U.S. Coast Guard, Intergovernmental Maritime Consultative Organization (IMCO), Environmental Protection Agency (EPA), Environment Canada, and others further reduces the level of risk. Since the concern is equally significant in non-winter periods, developments accomplished through the plan could produce overall beneficial effects.

1.17 Opposition to Winter Navigation on the St. Lawrence River. The State of New York and U.S. Department of the Interior steadfastly oppose the extension of winter navigation on the St. Lawrence based on potential environmental and economic disbenefits. The proposed Adaptive Assessment Methodology, provided by U.S. Fish and Wildlife Service, Region 3, should produce resource management benefits and the desired baseline information. The provision of a "no dredging" plan for the St. Lawrence River removes a major objection, but unresolved issues remain.

Relationship of Plans to Environmental Requirements

1.18 Compliance with Sections 404(b)(1) Guidelines and Section 404(r), Public Law 92-500.

Evaluation of the discharge of dredged or fill material into waters of the United States, including consideration of the Section 404(b)(1) guidelines and

meeting the requirements of Section 404(r), Public Law 92-500, as amended, will be included in follow-on EIS's as required prior to any discharge. This study, in its current stage of development as a General Investigation, does not contain sufficient specificity with regard to locations of disposal sites to permit the required evaluations. Specific locations and evaluations would be developed and presented in EIS's accompanying the Phase I General Design Memorandums.

1.19 Compliance with E.O. 11988 (Flood Plain Management) and E.O. 11990 (Wetlands Protection) would be done to the extent allowable at the Phase I stage of the Program. Site specific coordination with Federal, State and local planners would be done as follow-on planning and design stages address specific areas.

1.20 Other environmental requirements of the project, as related to alternative plans proposed, are summarized in Table I-1.

TABLE I-1
RELATIONSHIP OF PLANS TO
ENVIRONMENTAL REQUIREMENTS

STATUTES	EXTENDED NAVIGATION SEASON	NO ACTION (31 January ± 2 WEEKS)
Clean Air Act, as amended, 42 U.S.C. 7410 et. seq.	*	Inacted subsequent to document.
Clean Water Act of 1977, 33 U.S.C. 1344	*	Inacted subsequent to document.
Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et. seq.	*	Coordination has been established with the Standing Committee for Coastal Zone Management of the Great Lakes Basin Commission.

NOTES: * - This Programmatic Environmental Impact Statement on Extended Navigation Season Program provides the program for securing the information required. The feasibility study, in its current stage of development as a General Investigation, lacks sufficient specificity to make a final determination at this time. An evaluation would be accomplished during future planning efforts in completing the Phase I General Design Memorandums and associated EIS's.

** - A reconnaissance archeological survey to locate potential historical-cultural sites subject to impacts resulting from activities of the recommended extension of winter navigation on the Great Lakes and St. Lawrence River System satisfies the statute requirements.

*** - The No Action alternative in its current stage of development does not provide all the information required. An evaluation would be accomplished during future planning efforts in completing the Phase I General Design Memorandums and associated EIS's.

TABLE I-1 (Cont'd)

STATUTES	EXTENDED NAVIGATION SEASON	NO ACTION[1/] (31 January ± 2 WEEKS)
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et. seq.	Compliance assumed based on existing data. Coordination with FWS is continuing.	Full Compliance
Federal Water Project Recreation Action Act, 16 U.S.C. 460 et. seq.	*	***
Fish and Wildlife Coordination act of 1958, 16 U.S.C. 661 et. seq. (P.L. 85-624)	Full Compliance - The Fish and Wildlife Coordination Act Report will be placed in its entirety in the Environmental Impact Statement on Extended Navigation Season Program.	Full Compliance.
Historic Sites Act 1935, as amended, 16 U.S.C. 469 et. seq.	Full Compliance - **	Full Compliance
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et. seq.	Full Compliance - **	Full Compliance
Preservation of Historical and Archeological Data Act of 1974, as amended 16 U.S.C. 469 et. seq.	Full Compliance - **	Full Compliance
Protection of Bald and Golden Eagles Act, 16 U.S.C. 668-668d	*	***

1/Based on Interim I Feasibility Report Final Environmental Impact Statement on the Great Lakes/St. Lawrence Seaway Navigation Season Extension Program dated September 1977.

TABLE I-1 (Cont'd)

STATUTES	EXTENDED NAVIGATION SEASON	NO ACTION (31 January ± 2 WEEKS)
Rivers and Harbor Act of 1970 (P.L. 91-611, 31 Dec 1970)	Full Compliance	Full Compliance
Water Resources Development Act of 1976 (P.L. 94-587, 22 Oct 1976)	Full Compliance	Law enacted after Interim Report (March 1976).
Noise Control Act of 1972 (P.L. 92-574, 96 Stat. 1234)	*	***
Rivers and Harbor Act of 1899, 33 U.S.C. 401, et. seq.	*	Full Compliance
National Environmental Policy Act, as amended, 42 U.S.C. 4321 et. seq.	Full Compliance	Full Compliance
Freedom of Information Act, 5 U.S.C. 552	Full Compliance	Full Compliance

TABLE I-1 (Cont'd)

EXECUTIVE GUIDELINES	EXTENDED NAVIGATION SEASON	NO ACTION (31 January $\pm$ 2 WEEKS)
Executive Order 11514, Protection and Enhancement of Environmental Quality, 5 March 1970, as amended by Executive Order 11991, 24 May 1977 (42 FR 26967, 25 May 77)	*	Law enacted after Interim Report (March 1976).
Executive Order 11593, Protection and Enhancement of Cultural Environment, 13 May 1977 (36 FR 8921, 15 May 77)	*	Law enacted after Interim Report (March 1976).
Executive Order 11988, Floodplain Management, 24 May 1977 (42 FR 26951, 25 May 1977)	*	Law enacted after Interim Report (March 1976).
Executive Order 11990, Protection of Wetlands, 1977 (42 FR 26961, 25 May 1977)	*	Law enacted after Interim Report (March 1976).
CEQ Memorandum of 30 August 1976, Analysis of Impacts on Prime and Unique Farmlands	Full Compliance	Law enacted after Interim Report (March 1976).

TABLE I-1 (Cont'd)

APPLICABLE FEDERAL REGULATIONS	EXTENDED NAVIGATION SEASON	NO ACTION (31 January + 2 WEEKS)
"Navigable Waters Discharge of Dredged or Fill Material," (40 CFR 230.1-230.8), EPA	*	***
"Protection of Historic and Cultural Properties" (36 CFR 800, 30 Jan 79) Advisory Council on Historic Preservation	Full Compliance - **	Law enacted after Interim Report (March 1976).
"St. Marys Falls Canal and Locks, Michigan," (33 CFR 207.440), Corps	Full Compliance	Full Compliance

II. NEED FOR AND OBJECTIVES OF STUDY

Study Authority

2.01 Events which catalyzed efforts to extend navigation on the Great Lakes-St. Lawrence Seaway into winter, include:

1. Development of the taconite pellet process, with low moisture content (no freezing) made shipment of low grade iron ore economically feasible. Early 50's.

2. St. Lawrence Seaway development allowed seagoing vessels to reach lake ports. Late 50's.

3. Electricity from dams and power facilities in the eastern end of the seaway created an interest in industrial development and in the "Fourth Seacoast." Early 60's.

4. Extending winter navigation to increase use of water resources of Great Lakes-St. Lawrence Seaway. Study authorized in 1965 to determine feasibility, recommended further study as merited (1969).

2.02 A multi-faceted program was authorized in 1970 (P.L. 91-611). Section 107(a) provided for a survey study to determine feasibility of means for extending the winter season, as recommended in 1969; Section 107(b) authorized the Demonstration Program to field-test the means; and Section 107(c) completed in 1972 authorized a study of ways and means to provide reasonable insurance rates for shippers and vessels engaged in extended winter navigation. Updated in 1978.

Public Concerns

2.03 The Fish and Wildlife Coordination Act of 1958 (P.L. 624-85). This requires that equal consideration be given to fish and wildlife conservation, to be coordinated with other features of water resource development programs. The Environmental Plan of Study was compiled by the U.S. Fish and Wildlife Service for the Corps. It is a brief summary of needs and concerns. In addition, the Fish and Wildlife Coordination Report, Appendix G, provides relevant resource information and identifies related needs.

2.04 The National Environmental Policy Act of 1969 (NEPA). This requires the equal consideration of environmental amenities during the planning of Federal projects, partly achieved through public coordination. Formal and informal coordination, initiated in 1972 for the Extended Winter Navigation Program, became a permanent part of the Program. A prevalent concern expressed by the public is the economic benefit to large companies at the expense of the individual taxpayer and the environment, resulting in a net loss to the latter. Environmental concerns included depletion and

degradation of natural resources, shore damages, and other environmental impacts.

2.05 Council on Environmental Quality, 1978. When appropriate, new guidelines for preparing environmental statements encourage the use of the programmatic EIS. The programmatic EIS reduces excessive paper work by covering a specific program within a broad geological area, su[illegible]izing the environmental impacts within the regional scope, eliminating repetitive discussions of the same issue, and discussing issues in a plain, analytic manner. System-wide and area-specific concerns would be addressed throughout the program, over time, as required by new developments and information.

2.06 A summary of public concerns, presented below, represents those identified through agency input, coordination, and correspondence. These concerns are addressed in this report. Comments in response to the Draft Environmental Statement are summarized (EIS-Section VI), and responses are provided in Appendix C.

Environmental Needs

2.07 The need for a coordinated and integrated environmental-engineering approach became apparent through the several years that the Extended Navigation Season Demonstration Program was conducted. The need stems from three inter-linked sources: (1) little information exists concerning the ecosystem, particularly aquatics, of the Great Lakes and St. Lawrence River from the late fall to early spring months; (2) the vast geographic expanse of the study area; and (3) there are no similar existing ice navigation programs of this magnitude from which impacts for the proposed action could be studied or extrapolated. The two factors - lack of existing environmental data and absence of a similar project - have greatly handicapped a detailed assessment of impacts and underscore the need for an integrated approach from project planning to actual operation.

2.08 Of the limited experiences of ice navigation on the Great Lakes, the eight year Extended Navigation Season Extension Program is the most extensive and systematic. Operation of the Demonstration Program, albeit on a limited scale, did not reveal any adverse impacts that prohibit further consideration of the full Navigation Season Extension Program. A number of perceived, potential and hypothetical adverse impacts have been suggested, but only limited evidence exists to support them. While socially oriented impacts have been determined and addressed in the Environmental Impact Statement (EIS), the above-cited paucity of winter ecosystem data prevents impact predictions of unqualified confidence from being made at this time. This, in large measure, is the reason for the presentation of this Programmatic EIS at this time, and the larger whole Adaptive Method process.

2.09 Also, significant biological changes affected by environmental modification, due to man's activity, are often not detected until several

years after the initial change has taken place. The immediate impact, which may range from the spectacular to the undetectable, is a deceptive measure of long-term, often more significant changes in the ecosystem. Hence, the incorporation of the Adaptive Method process.

2.10 Realizing at the onset that its completion preceeded the passage of NEPA by more than a decade, the original opening of the St. Lawrence Seaway can be used as an analogy to illustrate the potential for adverse impacts on the Great Lakes ecosystem that could result without the type of investigations being recommended. Representative of their era, but in contrast to today's awareness, little environmental data base was developed, little ecological impact prediction, and no environmental assessments were formally made to determine the environmental feasibility of the Erie Canal, which provided access from the Atlantic Ocean to the Great Lakes, and the Welland Canal, which bypassed the block between Lakes Ontario and Erie created by the Niagara Falls. The result was a long time lag between the physical alteration of the system and some major changes in biological communities in the Great Lakes. The change, the establishment of the alewife (Alosa pseudoharengus), was explosive and, along with the coincidental impact of the sea lamprey (Petromyzon marinus), resulted in major shifts in the abundance, composition, distribution, and growth of the fish fauna throughout the Great Lakes. Social problems accompanied the biological changes. To minimize the environmental risks, so that similar destructive problems would not arise as a result of winter navigation, an adequate data base would be developed and an accurate identification of system-wide and site-specific potential impacts would be made. It is essential to make reasonably certain that environmental alterations do not result in unacceptable, and irreversible long-term environmental degradation of any part of the Great Lakes system. The proposed program aimed at prevention and avoidance of adverse effects through comprehensive studies, is specifically designed to avoid expense to future generations.

2.11 For these reasons, the Adaptive Method Approach includes an adaptive environmental assessment technique and an Environmental Plan of Action. The objective of the adaptive environmental assessment technique, being prepared by the U.S. Fish and Wildlife Service for the Corps, is to provide decision-makers with a systematic means to deal with the foreseen as well as with the unforeseen consequences which could occur within a dynamically changing system. The adaptive approach is basically consistent with the Corps policy relative to the National Environmental Policy Act of 1969: preliminary determination of environmental impacts and feasibility in pre-authorization stage; detailed determination of environmental impacts and design modifications during post-authorization planning; and monitoring of the environment and modifications of operating procedures during construction and operation stages.

2.12 A large number of variables in the total Great Lakes System are therefore compressed under the adaptive assessment technique and could provide an organized framework from which the basic dynamics of the system would be derived. The technique concentrates on defining and ordering

issues and components as a systematic approach for insuring that environmental quality would be maintained. It is recognized that unexpected impacts could occur. In response to this, the adaptive assessment technique emphasizes the response which reacts to the unexpected under the Adaptive Method Approach. Early detection and response to unexpected impacts are essential to provide the necessary checks and balances to assure protection of the environment.

2.13 Functional aspects of the Adaptive Method Approach are shown in Figure 2. That diagram outlines the plan, showing basic time frames, reports required, and inherent checks and balances.

2.14 Triangle 1 represents completion of the Winter Navigation Survey Report which is scheduled for December 1979. Triangle 2 represents an anticipated Congressional authorization and appropriation of funds which could occur about 1982, should the Congress authorize the selected Plan for continued planning, design, and construction. Since the actual time for such authorization is unknown, the schedule on the diagram designates this point as year zero for scheduling subsequent activities and reports.

2.15 At year zero, following appropriations, the Corps of Engineers (COE) would begin several geographically oriented detailed planning studies concurrently with the assistance of appropriate agencies such as the Fish and Wildlife Service in order to obtain environmental base conditions and inventory data. After a period of up to 3 years, sufficient environmental and engineering information would have been developed to make engineering decisions and to allow final preparation of an EIS which would accompany its mutually supporting Phase I General Design Memorandum (GDM) to higher COE authority for approval. This EIS would be based on evaluation of the base condition data from both site specific and system-wide studies. Using the Fish and Wildlife Service (FWS) Assessment Methodology Technique, the EIS would predict all impacts known at that time that could be expected to result from the Program and would provide details on monitoring considered necessary to guard against unanticipated adverse impacts. As is true for all EIS's, these documents would receive full public scrutiny. On the diagram, the assessment and impact prediction would occur between Triangles 3 and 4.

2.16 Underlying the Adaptive Method is the commitment that should the assessment indicate a need, the design of an item or planned activity could be modified during Phase I planning to mitigate, compensate for or eliminate adverse impacts.

2.17 After approval of the EIS and Phase I GDM, the Corps would begin Phase II studies. These are detailed engineering design studies leading to preparation of plans and specifications. System-wide studies would also continue during this period. At some point, about two years before construction is scheduled to begin (Triangle 6), the environmental base condition would be verified and updated in preparation for monitoring during construction and operation. Should the design be significantly

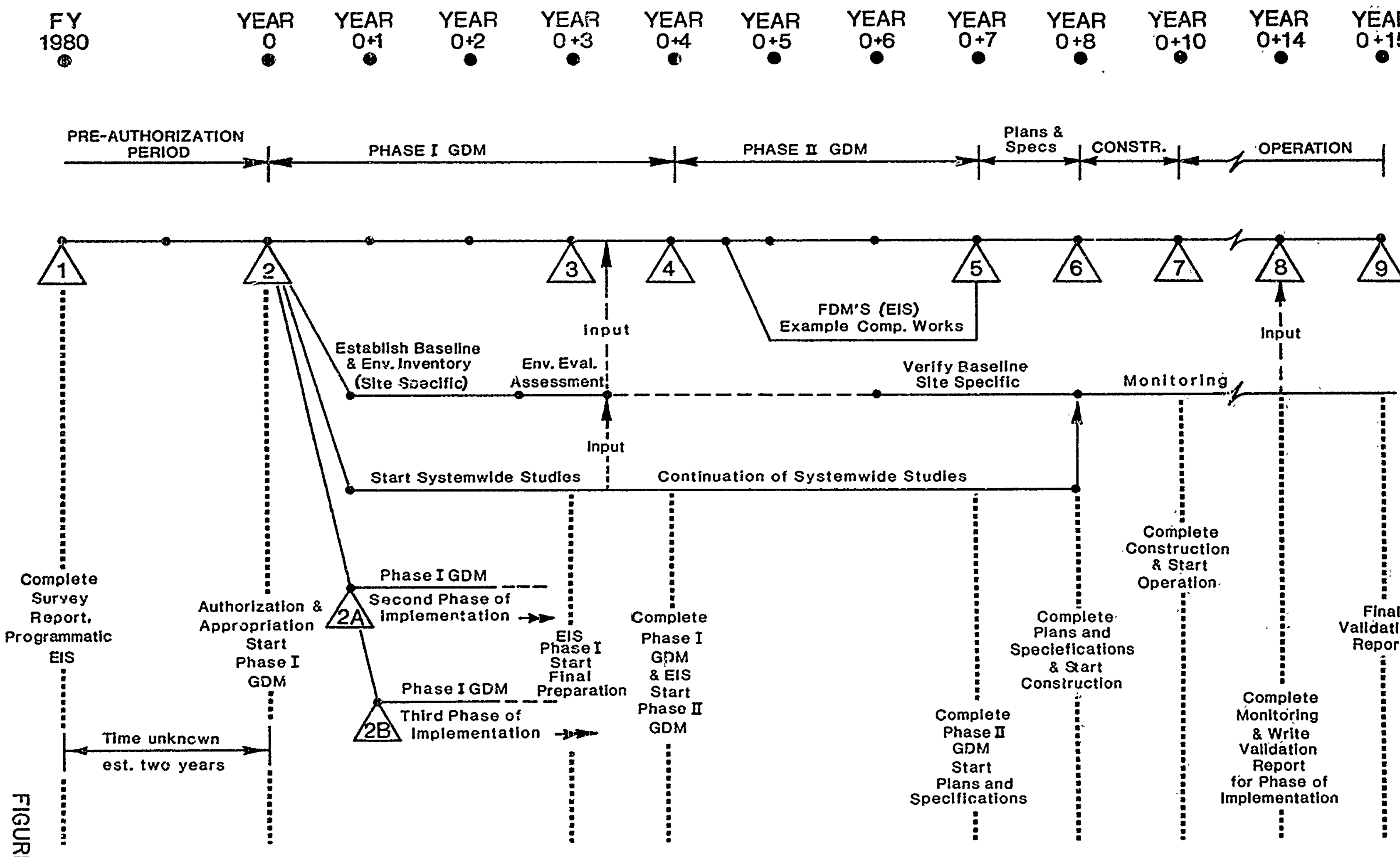


FIGURE I

ADAPTIVE METHOD DIAGRAM

altered or new information be developed showing a probability of a previously unanticipated impact, a supplement to the EIS, concerning only significance of changes or new information, would be prepared prior to construction. In addition, it is likely that for major construction activities, such as compensating works, a Feature Design Memorandum (FDM) would be prepared. This FDM would describe only one item of construction and also would require the preparation of an EIS if the structure were altered significantly from previously described plans or if new major potential impacts of the structure came to light since the previous EIS was completed.

2.18 During construction and operation (Triangles 7 through 8), environmental monitoring would be accomplished as a check on impact predictions and as a safeguard against unanticipated adverse impacts. The monitoring would compare the post-construction environmental conditions with pre-construction conditions. Should the monitoring indicate that a significant impact is occurring, any of several things would be done, depending on the nature of the impact. If the impact is found unacceptable, the cause would be eliminated, even to the halting of vessel traffic. If a lesser measure would accomplish a satisfactory result, it would be done. If an impact develops which is considered acceptable, but undesirable, appropriate measures would be taken to mitigate, compensate for or eliminate the impact.

2.19 The diagram, for clarity, shows only one phase of the proposed implementation and represents the effort needed for year-round navigation on the upper three Great Lakes. An example of another phase of implementation would be that for achieving extended season navigation on the St. Lawrence River (International portion).

2.20 A Validation Report would be completed for each phase of implementation. A Final Validation Report would be written summarizing all preceding reports. These would be prepared after environmental monitoring indicated that all impacts had been identified and evaluated and all efforts at compensating, eliminating or mitigating impacts had been taken. The Validation Reports would provide a review of data gathered and impacts determined versus those predicted from the information obtained so that a determination could be made whether or not operation should continue. The final Validation Report would provide the answer on the environmental acceptability of the Extended Season Program or any phase of the Pro.

Public Concerns and Related Resource Management Needs

2.21 Extended winter navigation is not restricted to a fixed operational period and has occurred year-round five times on the Upper Lakes within the last eight years. A record of the closing dates at the Soo Locks from 1967 through 1978 can be found in reference (1).

2.22 Environmental concerns related to extended winter navigation are principally associated with navigation-related activities taking place in

rivers and harbors. These activities potentially cause or contribute to such adverse effects as:

1. Shore erosion and shore structure damage.

2. Disruption of island transportation.

3. Resuspension and redistribution of bottom sediments.

4. Alteration of existing water levels.

5. Disruption to fish and wildlife life patterns (spawning and migration).

6. Decreased water quality.

7. Disruption of fish and wildlife habitats.

8. Alteration or destruction of benthic communities.

9. Changes in existing and future recreational potential, including disruption of recreation activity areas, access, and events.

10. Changes in recreation use patterns; including reduction of man-days sport fishing effort and increase in situations hazardous to the public.

11. Effects on occupational groups, such as individual safety and comfort, and "psycho-social" effects of an extended season.

12. Oil or hazardous material spills during the extended navigation season.

2.23 The requests by industry to extend the season to a maximum period grew out of economic needs for:

1. Less costly transportation.

2. More efficient utilization of the existing Great Lakes fleet.

3. Reduction of stockpiling of bulk commodities.

2.24 Their concerns included:

1. Safety and survival methodology.

2. The effect on personnel operating the vessels and locks.

3. High insurance rates.

4. The international aspects of winter navigation.

2.25 Power generating users of the Great Lakes-St. Lawrence Waterway System, having established controls which provided a compatible co-existence with the existing navigation interests, are concerned about the possibility of unprogrammed effects of winter navigation on hydroelectric power generation, the potential impact on water levels and flows, and the legal aspects of winter navigation.

2.26 The international character of the Great Lakes-St. Lawrence Seaway requires coordination and co-participation between the U.S. and Canada to establish year-round winter navigation in areas below Lake Erie.

Need for and Objectives of Action

2.27 Planning objectives identified from an analysis of the problems, needs, concerns, and opportunities within the study region were used as a general guideline for the plan formulation process. The objectives reflect the local, State and regional interests, plus related national economic development and environmental quality objectives. The planning objectives used in the plan formulation process are as follows:

a. Promote efficient utilization of the navigation intrastructure of the Great Lakes - St. Lawrence Seaway System.

b. Contribute to an increase in output of goods, services, and external economics of the Great Lakes - St. Lawrence Seaway System.

c. Contribute to the maintenance of the required water levels of the Great Lakes and discharge of the St. Lawrence River.

d. Promote the maintenance of Great Lakes island settlements as viable social communities.

e. Contribute to the quality of the Grea' Lakes - St. Lawrence Seaway environment, giving particular attention to the winter ecosystem and water quality of the Lakes.

2.28 Planning constraints used are:

a. Avoid or minimize damage to shorelines, structures and wetlands from vessel induced increased ice pressure or ice movement.

b. Avoid adverse effects to power plants by promoting a stable ice cover and the required river discharge.

c. Avoid adverse effects to low-lying communities from project-induced hanging dam and ice jam flooding.

d. Avoid adverse impact to the overall water quality of the Great Lakes.

e. Avoid irreversible commitments of resources prior to determining the full ramifications of the proposed actions.

III. ALTERNATIVES

Plans Eliminated From Further Study

3.01 Demonstration of Means to Extend Winter Navigation. Field-testing of activities related to extending winter navigation began during the winter of 1971-72 with the Demonstration Program authorized by Section 107(b) of P.L. 91-611. The goal of the Demonstration Program was to determine the practicability of various methods, both structural and nonstructural, to maintain safe navigation in ice. No unacceptable adverse environmental effects were identified throughout these demonstrations according to the environmental statements. Authorization for the Demonstration Program expired at the end of FY-79.

3.02 Extension of Winter Navigation to 31 January ± 2 Weeks. This is proposed and assessed in the Interim I Feasibility Report and Final Environmental Impact Statement for Extended Winter Navigation on the Great Lakes-St. Lawrence Seaway System, completed and forwarded for review by Detroit District Corps of Engineers in March 1976. Environmental effects would be reviewed through use of an Environmental Appraisal Program in connection with all activities required.

3.03 Fixed Navigation Season Alternative. The Fixed Navigation Season alternative involves the same type of operation as the Traditional Navigation Season alternative. However, a fixed navigation season would be imposed on the St. Marys River at the Soo Lock facilities between 1 April and 15 December. Earlier closing and later opening dates would be dependent upon ice conditions in harbors and Lakes. Traditional navigation would occur in the remainder of the system as described below. This plan was considered as an alternative to the extension of winter navigation to 31 January, ± 2 weeks for the upper four Great Lakes, Interim Report of March 1976.

3.04 The Traditional Navigation Season Alternative. With this plan navigation could continue beyond the fixed closing date of 15 December through the Soo Locks provided weather and ice conditions allow for safe passage. On an average, without structural improvements or mitigative measures, ice conditions on the St. Marys River reach the point where these special measures are required by approximately 25 December to 1 January. This alternative was also considered in the Interim Report of March 1976 and the plan selected was to extend winter navigation to 31 January ± 2 weeks for the upper four Great Lakes. Table III-1 shows actual season extension over a 12 year period.

TABLE III-1

CLOSING DATES OF THE SOO LOCKS
1967-1979

		Demonstration Program Measures			
Winter Season	Closing date	Ice Booms	Bubbler-Flusher	Airboats	Sunken Scows & Craneweights
1967-68	31 Dec 67				
1968-69	4 Jan 69				
1969-70	11 Jan 70				
1970-71	29 Jan 71				
1971-72	1 Feb 72				
1972-73	8 Feb 73				
1973-74	7 Feb 74			X	
1974-75	Not Closed		X	X	
1975-76	Not Closed	X	X	X	
1976-77	Not Closed	X	X	X	X
1977-78	Not Closed	X	X	X	X
1978-79	Not Closed	X	X	X	X

3.05 Extension of Land-Based Transportation Systems Supplementary to Traditional Navigation Season. Alternatives evaluated in the March 1976 Interim Feasibility Report included consideration of alternative modes of transportation. Criteria included the capability to meet demands of commodities served and the investment efficiency with improvements having low net costs. The Traditional Season and Fixed Season alternatives included such modes of transportation as rail and car ferry operations on Lake Michigan and on the St. Clair and Detroit Rivers; car ferries on the St. Marys River; coal movement from Toledo to Detroit; and various petroleum product movements in Lake Michigan and the St. Clair-Detroit area. Transportation rates for ferry and rail transportation of bulk commodities (such as coal, taconite and petroleum products) were found to be more costly than vessel rates. In addition, the smaller capacity of ferries and rail would limit the economic transport of bulk commodities. For these reasons, alternative land based transportation modes were not considered to be a viable alternative for extending winter navigation.

Conditions Without Project Implementation: (No Action)

3.06 General cargo, if needed, would be moved by alternative modes of transportation during severe winter months after 31 Jan ($\pm$ 2 wks).

Bulk commodities are normally stockpiled during this time. Ice thicknesses up to several feet, tight turns in the St. Marys River, lack of winterized navigation aids, lower power capabilities of vessels, and increased risks reflected in increased marine insurance costs have, in the past, discouraged shipping during the winter months.

3.07 Traditional navigation season traffic would continue to move throughout the entire winter months (December-March). Major non-ice-restricted harbors (up to 31 January) in Lake Superior are Two Harbors, Taconite, Silver Bay, Presque Isle, and Marquette. On the lower lakes: Lake Michigan - Burns, Gary, Indiana, Milwaukee, Calumet, Muskegon, and Ludington; Saginaw River; Detroit Harbor; and Lake Erie - Toledo, Lorain, Cleveland, Ashtabula, Conneaut and Buffalo.

3.08 The operational activities proposed in Interim Report No. 1 for implementation have been considered in relation to an overall extended season program on the entire Great Lake-St. Lawrence system. These activities would be in addition to ongoing activities, funded separately by agencies or covered by statutory mandates that would be accomplished even without authorization of an extended season program as proposed in Interim Report No. 1. Activities proposed are as follows:

a. Icebreaking Assistance
b. Navigation Aids
c. Operation of the Ice Navigation Center
d. Shore Unit and Aerial Ice Reconnaissance
e. Ice and Weather Forecast Operations
f. Ice and Water Data Collection
g. Ice Jam Monitoring Program in the St. Marys and St. Clair Rivers and a Monitoring Program to Observe the Natural Ice Bridge Formation at Port Huron, Michigan
h. Lock Operations at Sault Ste. Marie, Michigan
i. Operation of Lime Island Airboat, St. Marys River
j. Operation of Bubbler-Flusher Unit, Sugar Island, St. Marys River
k. St. Marys River Ice Booms at Little Rapids Cut
l. 3 Year Environmental Appraisal Program
m. Shore Erosion and Shore Protection on St. Marys, St. Clair and Detroit River System.

3.09 Continuation of the activities above would assure continuity with data and observations collected during the Demonstration Program, since 1972, enabling further refinement in evaluations of the systems proposed. This factor is particularly relevant to the Sugar Island bubbler-flusher and St. Marys River ice booms, whose primary functions are to alleviate adverse social effects resulting

from extended season operations. Commercial shipping interests would realize benefits in the form of greater returns on capital expenditures on commercial transport vessels. Increased duration of employment of dock and stevedore personnel would be proportional to the length of extended season activities.

3.10 Shore erosion and shore structure damages occur under existing conditions from natural ice, and wave and wind forces. Extension of the navigation season to 31 January could contribute to those damages. Structural damage that occurs below the ordinary high water mark is subject to navigation servitude and the Federal Government would not be liable for such damages caused by winter navigation. The Federal Government would probably not be liable for erosion which occurs as a direct result of season extension. Mitigation measures would be taken, and studies continued in affected areas identified.

3.11 Ice conditions in the Great Lakes-St. Lawrence Seaway System pose difficulties beyond the interruption of shipping. Ice jams occur as loose ice shifts and constricts areas and can cause upstream flooding, threaten power production at hydroelectric plants in the St. Marys, Niagara and St. Lawrence Rivers, and damage to docks and other shore structures. Ice floes and ice jams also hamper ferry operations. These impacts have occured and can occur under natural conditions in rivers and harbors.

3.12 Great Lakes Basin States value the Great Lakes for expanding recreational needs such as ice fishing, snowmobiling and skiing. Industries related to winter recreation are growing in economic importance. These activities could continue after 31 January in fast ice.

3.13 The results of environmental studies accompanying operations to 31 January (Environmental Appraisal Program) would provide information for the Environmental Plan of Action (EPOA), using the Adaptive Method technique identifying specific priorities for study or for re-evaluation.

3.14 Significant numbers and kinds of wildlife use the water, shorelands and adjacent basin areas of the Great Lakes for part of their life cycle in winter. Little is known about winter habitats and winter use of them. Sampling methods required for identifying this information are lacking or experimental.

3.15 <u>Existing Plans and Improvements to the Navigation System.</u> Improvement of the connecting channels was authorized on 21 March 1956. To provide safe draft for Great Lake freighters, project depths from 27 to 30 feet have been available through the connecting channels since June 1962.

3.16 To take full advantage of the 27-foot Connecting Channel Project, 31 harbors were improved accordingly. The Corps of

Engineers has underway a study investigating the feasibility of further improvements in the Great Lakes connecting channels and harbors for safe operation of vessels up to the maximum depth permitted by the locks at Sault Ste. Marie (32 feet).

3.17 The Connecting Channel Study includes an investigation to determine the advisability of providing additional lockage facilities and increased capacity at the locks at Sault Ste. Marie, Michigan.

3.18 Independent studies are ongoing for selected harbors within the system and for twinning of the United States locks in the St. Lawrence Seaway. These are long-range studies which would be completed several years into the future.

Plans Considered in Detail

3.19 Extended Winter Navigation. This plan consists of both nonstructural and structural improvements to permit a permanent extension of the navigation season on the upper four Great Lakes and ten months navigation through the Lake Erie-Lake Ontario-St. Lawrence River portion of the system. Since 1976, additional analysis has been done with regard to the improvements necessary to enhance the efficiency and capacity of operation of a permanent system-wide extended navigation season program and to maximize the net economic benefits that could be realized, and to implement an environmental plan of action that would provide for maintenance and enhancement of environmental quality based on the results of this analysis, the extended navigation strategy is the proposed plan and is intended to provide for the environmental quality objectives.

3.20 Proposed and tentatively proposed activities associated with this alternative are identified as follows. Some of the harbors identified are not cost-effective. They are still included here to illustrate what was evaluated.

A. LAKES - CONNECTING CHANNELS, INCLUDING THE ST. LAWRENCE RIVER.

1. Icebreaking Requirements

a. Projected, eventual icebreaking vessel requirements

4 Type B*
20 Type C*

*Type B is a major icebreaker capable of breaking 2-3 ft. of ice without backing and ramming i.e. MACKINAW AND WESTWIND

*Type C is a vessel specially equipped for icebreaking capable of breaking 1.5 to 2 ft. of ice without backing and ramming. (i.e. 140 foot WTGB class)

2. Vessel Traffic Control
   a. For prevention of collision/rammings/groundings
   b. For voyage following assessment
   c. For convoying and icebreaking scheduling

3. Ice Data Collection/Dissemination

4. Ice and Weather Forecasts

5. Aids to Navigation

   a. Mini-LORAN-C
   b. RACON

6. Ice Control Structures

   a. St. Marys River - Sugar Island - 400 ft. boom and 1,000 ft. boom, (2) rubblemound islands
   b. Lower end Lake Huron - 1,200 ft. and 3,200 ft. booms
   c. Lower end Lake St. Clair - 1,600 ft., 3,200 ft., and 1,200 ft. booms
   d. Ogdensburg, New York - 2,000 ft. heavy duty boom and 1,000 ft. sections of light duty booms
   e. Cardinal, Ontario - 3,300 ft. heavy duty boom
   f. Iroquois Dam

      1) Upstream - 6 booms - 1,200 to 6,000 ft. boom
      2) Downstream - 3 booms - 1,200 to 6,000 ft. boom

7. Air Bubbler System

   a. Whitefish Bay, Birch Point Turn - 10,000 ft.
   b. Middle Neebish Channel, Angle Courses 5-6 5,000 ft.
   c. Middle Neebish Channel, Angle Courses 6-7 5,000 ft.
   d. Middle Neebish Channel, Angle Courses 7-8 3,000 ft.
   e. Middle Neebish Channel, Angle Courses 8-9 3,000 ft.
   f. Lime Island, Lime Island Turn - 5,000 ft.

8. Lock Modifications

   a. Soo Locks

      1) Co-Polymer coating and steam hoses
      2) Bubbler flusher
      3) Bubbler system
      4) Removal of ice by tug
      5) Installation of large gate valves

b. St. Lawrence River

1) Coating lock walls and gates
2) Removal of ice by tug
3) Gate and equipment heating
4) Gate recess bubbler/flushers

9. Dredging and Disposal

a. 3.0 million cubic yards, to allow for two-way traffic in Middle Neebish Channel (St. Marys River) upon development of the need when traffic eventually builds up and so demands.

10. Compensating Works (if required by levels and flows considerations)

a. St. Clair River - Stag Island Area

b. Detroit River - Peach Island Area

11. Shoreline Protection

a. Shoreline erosion protection
b. Shore structure protection

12. Island Transportation Assistance

a. Sugar Island Ferry - dock bubbler
b. Lime Island - ice boat
c. Drummond Island Ferry - restudy
d. Harsens Island -study
e. Grindstone Island - tug ferry

13. Connecting Channel Operational Plans for Sugar Island, Drummond Island, and St. Clair, Detroit and St. Lawrence Rivers.

1) Icebreaking assistance
2) Emergency ferry service - stud[illegible] alternate routes
3) Land transportation service
4) Public notification of anticipated ferry difficulty
5) Emergency medical evacuation service

14. Water Level Monitoring

15. Vessel Speed Control and Enforcement

a. Monitored by Doppler radar
b. Speeds limited

16. Safety/Survival Requirements

17. Vessel Operating and Design Criteria

18. Search and Rescue Requirements

19. Oil/Hazardous Substance Contingency Plans

20. Vessel Waste Discharge

    a. Clean Water Act 1977, through the EPA, established standards for vessel discharge.

    b. Study of vessel related wastes disposal: black water (human wastes) gray water (non-human wastes), other (bilge, ballast, solid wastes, and air pollutants)

21. Vessel Waste Discharge (Human) Requirements

22. Environmental Plan of Action

23. Pilot Access

    Require icebreaking tugs (4) Detour (1)
    Detroit (1)
    Cape Vincent (2)

24. Channel Clearing Craft: wide beam barge and towing vessel for Duluth-Superior Harbor

25. Vessel Captain/Pilot Training

B. HARBORS

1. Icebreaking Requirements

    a. Commercial tugs on an "as-needed" basis - cost to ship owner or port authority

    b. Locations

        1) Silver Bay, MN
        2) Duluth-Superior, MN-WI
        3) Ashland, WI
        4) Marquette, MI
        5) Escanaba, MI
        6) Green Bay, WI
        7) Muskegon, MI
        8) Ludington, MI
        9) Alpena, MI

10) Saginaw, MI
11) Monroe, MI
12) Toledo, OH
13) Sandusky, OH
14) Huron, OH
15) Buffalo, NY

2. Ice Control Structures

a. Harbor entrance modifications using ice booms

b. Locations

1)	Indiana Harbor, IN	4,000 ft. boom
2)	Muskegon, MI	4,800 ft. and 2,800 ft. boom
3)	Saginaw, MI	10,000 ft. boom
4)	Ludington, MI	5,200 ft. and 2,800 ft. boom
5)	Huron, OH	1,600 ft. boom
6)	Lorain, OH	5,200 ft. and 1,600 ft. boom
7)	Cleveland, OH	2,000 ft., 1,200 ft. and 1,600 ft. boom
8)	Ashtabula, OH	2,000 ft., 3,600 ft. and 1,600 ft. boom
9)	Conneut, OH	4,000 ft., 2,400 ft. and 1,200 ft. boom

3. Air Bubbler Systems

a. Locations

1) Duluth-Superior, MN-WI (8) 1,000 ft., (2) 2,000 ft. (1) 3,000 ft. (2) 4,000 ft.
2) Ashland, WI (1) 1,000 ft.
3) Marquette, MI (1) 1,000 ft.
4) Escanaba, MI (4) 4,000 ft., (1) 1,000 ft.
5) Alpena, MI (2) 1,000 ft.
6) Monroe, MI (2) 2,000 ft.
7) Calumet Harbor, IL (2) 1,000 ft., (1) 2,000 ft., (1) 4,000 ft.
8) Sandusky, OH (1) 1,000 ft.
9) Huron, OH (2) 2,000 ft.

4. Aids to Navigation

a. Proposed fixed navigation lights (FNL)
b. Locations

1)	Duluth-Superior, MN-WI	6
2)	Green Bay, WI	4
3)	Saginaw Bay, MI	2
4)	Alpena, MI	1
5)	Toledo, OH	1

3.21 Mitigating measures are provided through certain activities of the Plan to direct the most efficient and beneficial course of action for relieving adverse impacts. Of principal concern in the mitigation policy is the protection of the health, welfare, and well being of residents and property owners adjacent to the waterways. Mitigating measures that have been incorporated into the Plan are:

1. Ice control devices (normally ice booms) to lessen potential ice jams by stabilizing the ice cover. This minimizes damage to shore structures, shorelines, ferry service, and due to backwater flooding. Control of ice flow and lessening of ice jams would potentially benefit power interests on rivers.

2. Protecting the shoreline to reduce erosion:
   St. Marys River 4.8 miles
   St. Clair River 0.75 miles
   Detroit River 0.77 miles
   St. Lawrence River 3.2 miles

3. Consideration of compensating measures for protection of shore structures.

4. Implementation of the Environmental Plan of Action (EPOA) to provide needed environmental information about the winter period.

3.22 Operational plans are proposed for the St. Marys and St. Clair-Detroit Rivers. The purpose of these plans is to outline the methods to be employed which would anticipate, prevent, or alleviate flood conditions that could otherwise occur.

3.23 Phases considered for the year-round extension on the entire Great Lakes-St. Lawrence Seaway system are graphically displayed in Figure 2.

3.24 A navigation season of up to ten months on the St. Lawrence River (International portion) would not require dredging and the extended navigation season alternative could, therefore, be regarded as a "no dredging" alternative.

Phased Implementation of Season Extension Plan

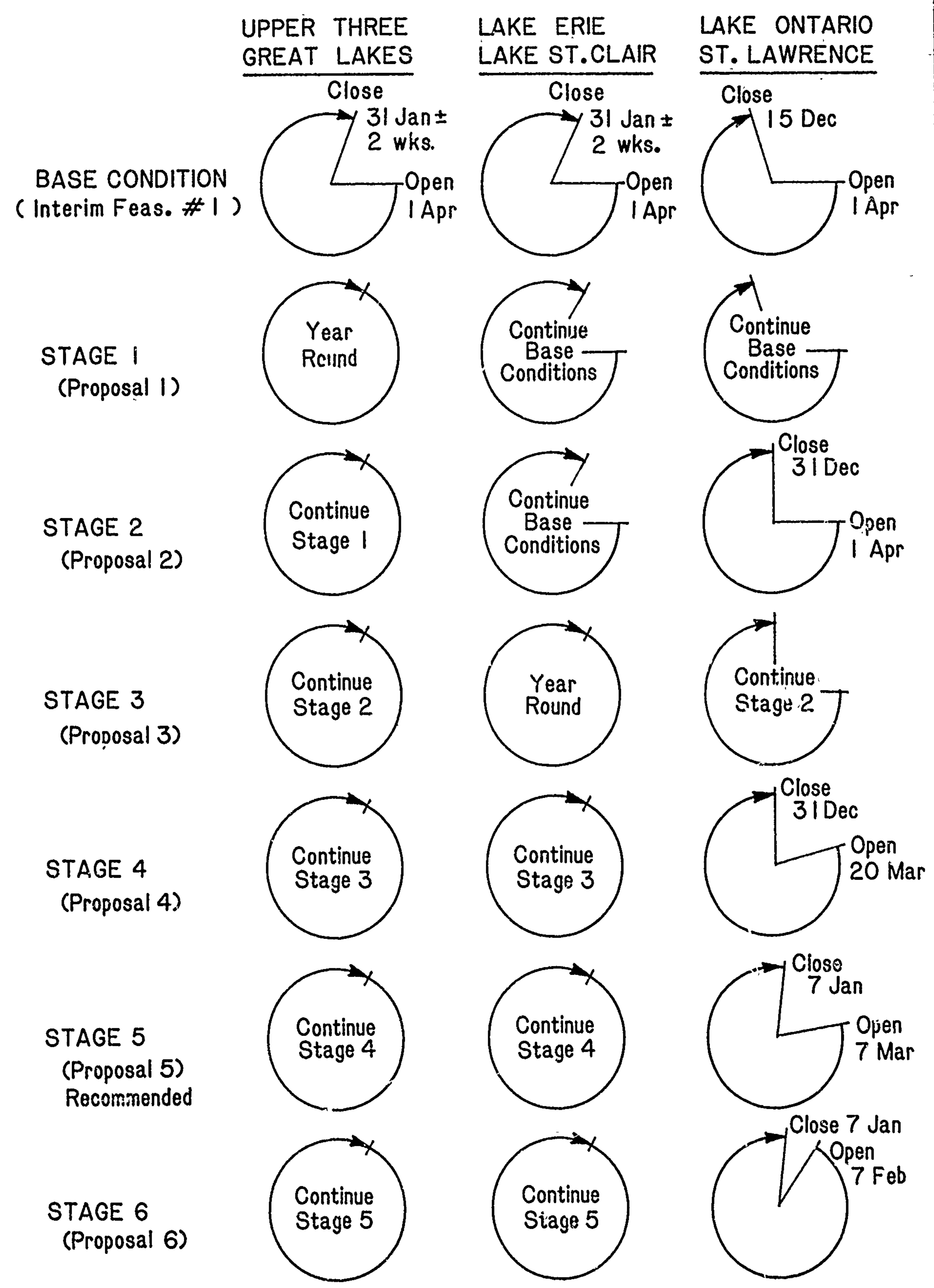


Figure 2

3.25 The eleven-month extension of navigation of the St. Lawrence River is not being recommended at this time due, among other reasons, to the need for additional engineering, economic, and environmental information on potential dredging required. The area studied is from Chimney Point to downstream of Ogden Island.

3.26 The twelve-months option would only be considered in connection with additional locks being constructed to provide the required period for lock maintenance. This is, therefore, not being considered at the present time as a feasible option. The Corps of Engineers has a separate study underway for consideration of improvement to the locks on the St. Lawrence River.

3.27 A comparison of impacts between the "No Action" plan and the Extended Navigation plan is provided in Table III-2.

Benefit/Cost

3.28 The Recommended Plan is year-round navigation on Lakes Superior, Michigan and Huron, up to 12 months navigation on the St. Clair River-Lake St. Clair-Detroit River System and Lake Erie, and up to 10 months navigation on Lake Ontario and the St. Lawrence River (international portion). The benefit/cost ratio for the plan is 4.0 with a total investment cost of $450,969,000, a total annual cost of $52,061,000, and total annual benefits of $205,666,000.

3.29 The current benefit to cost ratio as a dynamic value may not reflect all environmental disbenefits due to their present unquantifiable nature. However, the benefit/cost ratio does include the estimated cost for completing the environmental plan of action (EPOA), planned social mitigative measures such as island transportation assistance and compensating works, and to date, it is believed that no adverse environmental disbenefits have been identified which would substantially alter the benefit/cost ratio. If environmental disbenefits occur and can be quantified, the dollar cost would be included in the benefit/cost ratio. These revised benefit/cost ratios would be reviewed at each stage of planning and design to insure that no unfeasible plans proceed to construction. Refer to Appendix D for a more detailed discussion on benefits and costs.

EQ (Oriented) Plan

3.30 The Environmental Quality (EQ) oriented plan would maximize EQ values while addressing the planning objectives of the study and would emphasize contributions to the preservation, maintenance, restoration or enhancement of the environmental quality of the Great Lakes-St. Lawrence Seaway System. The Adaptive Method proposed in the Environmental Plan of Action (EPOA) is a technique for the

necessary evaluation of environmental impacts of system-wide extended season navigation and would be used to assure that a winter navigation project would be conducted in an environmentally and socially acceptable manner. The intent of the proposed plan is to provide for meeting the EQ objectives as opportunities are identified through the EPOA and Adaptive Method. The Adaptive Method would be accomplished concurrently with the implementation of the selected plan. The approach consists of implementing an Environmental Plan of Action for environmental base condition data collection, evaluation, and assessment; monitoring, and validation to be done concurrently with the continued planning and advanced engineering and design, construction, and operation phases of the selected plan. Management capabilities built into the Adaptive system could result in the development of an acceptable EQ project (Appendix D).

3.31 A summary of the Adaptive Assessment Methodology is provided in Table III-3.

3.32 It will be noted from Table 3 that the Adaptive process provides for the establishment of baseline conditions in a pre-construction and pre-operation stage of the project and for a validation period involving monitoring in a construction/operational phase. The complex process takes a systems approach through which variations from the baseline "frameworks" conditions are used for prediction, assessments and general management decisions. Although variations may occur at any time, in any part of the system--providing unpredicted effects--the most significant results might be obtained from changes occurring in the operational or monitoring phase. Variables in the system are adjusted to be responsive to change, consisting of such change factors as project effects, policies and issues in addition to the environmental factors.

3.33 Through the Adaptive process, an enormous amount of information about the Great Lakes-St. Lawrence system would be collected from existing and designed studies, all of which would be potentially useful within a prediction-assessment-management system.

3.34 The Environmental Plan of Action (EPOA) would provide a broad base of environmental data, related to project activities on a regional and area-specific basis. Program operations, sequentially planned, would provide a time or priority element for implementation.

TABLE III-2 COMPARATIVE IMPACTS OF ALTERNATIVES

	NO ACTION (31 JANUARY ± 2 WEEKS)	EXTENDED NAVIGATION SEASON
PHYSICAL ENVIRONMENT		
Air Quality	Vessel smog extends into winter months.	Due to increased vessel activity, an increase in pollution level could arise throughout the region, particularly in harbors and connecting channels.
Noise	*Noise in harbors and connecting channels from vessel activities continue on into the winter.	Noise in harbors and connecting channels would be evident for a longer period than "No Action".
	Vessel crews subjected to noise of vessel moving through ice-covered waters.	Vessel crew subjected to noise of vessel moving through ice-covered waters for longer period of time than "No Action".
	Transmission of vibrations directly to shore and shore structures by vessels moving in solid ice-covered constricted areas. (Evidenced only in the St. Marys River.)	Vessels moving in solid ice-covered constricted areas could transmit vibrations directly to shore and shore structures, for longer period.
Water Levels and Flows	*Reduction in the frequency of ice jams in the lower portion of the Little Rapids Cut in the St. Marys River due to installation of ice boom. This also tends to reduce loss of power production.	Minimize flooding potential, and resultant damage by installation of ice control devices and water level warning systems in the St. Marys and St. Clair Rivers. (Further investigations required to identify problem areas in the St. Lawrence River, particularly impacts on power production, and the necessary mitigation measures).

TABLE III-2 (Cont'd)

	NO ACTION (31 JANUARY ±2 WEEKS)	EXTENDED NAVIGATION SEASON
	*Ice jams in lower St. Clair River occur depending upon meteorological conditions. Records show jams to be minimal during December and January. Ice jam monitoring program mitigates this condition.	Potential for jams increases in February and March in St. Clair River. Ice jam monitoring program mitigates this condition.
Water Quality	*Danger of oil spill accidents from vessels moving in ice-covered waters.	Continued potential danger of oil spills by longer operation; however, research regulation and vessel construction would tend to reduce potential danger.
		Changes to local water quality in connecting channels and harbors expected level unknown.
		No large scale changes caused by air bubblers and possible resultant open-water.
Sediment Transport and Shore Erosion	*Continuance of natural shore erosion and sedimentation in the connecting channels (St. Marys and St. Clair Rivers) and Lakes. Potential damage to wetland communities in constricted channels due to vessel movement. Mitigation measures addressed.	Reduce potential shore erosion and sedimentation by shore protection (rip-rap) in the St. Marys River. Restricted vessel speeds past erodible areas. (Further detailed investigation of possible shore erosion sites in the entire system, including the St. Lawrence River, is required.)
		No significant effects by operation of air bubblers.
		Construction effects on sedimentation significant for dredging for short term. Expected recovery for long term.

TABLE III-2 (Cont'd)

	NO ACTION (31 JANUARY ± 2 WEEKS)	EXTENDED NAVIGATION SEASON
BIOLOGICAL ENVIRONMENT		
Benthic Communities	*No significant effect.	Impacts caused by icebreaking and vessel operations due to physical alterations (i.e., abrasion and scour of sediment.) Additional destruction to benthos by dredging to widen and deepen channels.
Vegetation	*Icebreaking and vessel operations in constricted areas result in the lateral and vertical movement of ice adjacent to shorelines. This ice movement can destroy some wetland vegetation if no protection is provided.	Significant impacts appear unlikely over large areas of the Great Lakes System, but local impacts could occur within constricted areas of the system.
Fisheries Resources	*Various program activities influence fish spawning, egg survival, behavior, distribution and habitats.	Could locally be affected through various program activities. The program activities in areas such as connecting channels, harbors and shallow water areas of lakes could influence fish spawning, egg survival, behavior, distribution and habitats. (Detailed assessments required to evaluate impacts. The EPOA would explore the effects of the project activities, the need for protection of certain areas, and the the need for mitigation of habitat losses.)
Wildlife Resources	*Potential effect upon animal migration in the St. Marys River. Continued aeration of aquatic habitat in ice-covered waters by vessel tracks broken in ice. Potential danger to wildlife by possible oil spills.	Migration of mammals that use ice cover for crossing water barriers could be affected. Vessel traffic could alter winter waterfowl habitat. (Detailed assessments required to evaluate impacts. The EPOA would explore the effects of the project activities, the need for protection of certain areas, and the need for mitigation of habitat losses.)

TABLE III-2 (Cont'd)

	NO ACTION (31 JANUARY ±2 WEEKS)	EXTENDED NAVIGATION SEASON
SOCIAL ENVIRONMENT		
Recreation	*Disruption of recreational activities along the connecting channels and in harbors (ice fishing, ice skating, snowmobiling) from vessel movement through ice-covered waters.	Disruption more long-term than "No Action".
Shore Erosion and Shore Structure Damage	*Adverse effect along ice-covered connecting channels (St. Marys and St. Clair Rivers).	Damage expected to exist. However, use of riprap and fracture line piling would mitigate damages of extended season, natural and traditional season. Restrict vessel speeds past erodible areas.
	Continuation and aggravation of natural shore erosion along the St. Marys River where investigated. (Straits of Mackinaw and the St. Clair and Detroit Rivers are naturally unstable ice areas.)	
Island Transportation	Installation of ice boom at the head of Little Rapids Cut in the St. Marys River help mitigate problems associated with winter navigation at the Sugar Island ferry crossing.	Re-installation of ice boom in the St. Marys River plus the installation of ice booms in the St. Lawrence River and at the head of the St. Clair River enhance ice-cover stability, thus mitigating most island transportation problems.
	Provision of air-boat for Lime Island residents in the St. Marys River would mitigate the problem of transiting across the river to the mainland. Ice flows from Lake Huron area cause potential stoppage to persons riding car ferries across the St. Clair River.	Ice boom possibly needed at head of Harsens Island to prevent interruption of ferry traffic. Further investigation required.

TABLE III-2 (Cont'd)

	NO ACTION (31 JANUARY ±2 WEEKS)	EXTENDED NAVIGATION SEASON
Occupational Groups (vessels, terminal, lock and pilot personnel)	*Hazardous impacts investigated. Mitigation measures identified: winterized safety and survival gear, improved quarters for crews to minimize safety and health concerns, lock and terminal facilities provide adequate winter safety measures.	Potential impacts would be reduced by more sophisticated onboard and shore navigation aids, vessel reporting systems, reconnaissance and information dissemination systems provided for winter operation. In addition, ice control devices would assist in the reduction of impacts ferry service across the St. Marys and St. Clair Rivers.
Community Cohesion	No significant effects.	No significant effects.
Community Growth	Reduced seasonal unemployment during the winter months in the non ice-restricted harbors; thus, more stable community growth.	Extended season navigation would reduce seasonal unemployment during the winter months in certain harbor communities, thus permitting more stable community growth.
Aesthetic Values	Investigation of effects: Increased activity and noise in connecting channels, harbors and lock areas by vessel passage on winter life styles. Vessel passage in winter waterways is unique and a proven attraction to some persons. Others strongly object.	Activity and noise in connecting channels, and areas would exist throughout entire winter.
Public Facilities and Services	Gradual increase in harbor facilities and related services to accommodate growth in the region.	Additional harbor facilities and related services would be required over that described in "No Action Plan" in order to accommodate extended season navigation.
Regional Growth	Increase, no estimate.	Net increases in labor earnings in region could result from navigation season extension.

TABLE III-2 (Cont'd)

	NO ACTION (31 JANUARY ±2 WEEKS)	EXTENDED NAVIGATION SEASON
Regional Employment and Labor Force	Increase in employment in region due in part to increased growth rate resulting from navigation.	Increase in employment in region could result due to increased growth rate resulting from extended season navigation.
Business and Industry	Some increase in business and industrial activity as a result of navigation.	Business and industrial activity would increase as a result of extended season navigation, particularly in the commercial shipping industry and in those industries that are users of the region's bulk commodities.
ECONOMIC ENVIRONMENT		
Total Investment (Capital replacement cost only)	$0.0	$450,969,000
Average Annual Benefit	$0.0	$205,666,000
Average Annual Costs	$0.0	$ 52,061,000
Energy	Incremental energy savings	There would be a small, but positive energy savings associated with increased waterborne commerce movement.
Power Production	Ice boom at the head of Little Rapids Cut reduced traditional ice jam occurrences in Little Rapids Cut area, and stabilized water levels and flows in the Soo Harbor area where power plants are located.	Minimal disruption of power production on St. Marys River by installation of ice control devices to stabilize ice cover and reduce occurrence of ice jams. (Additional studies would be made to identify possible benefits to power for winter navigation extension on St. Lawrence River.)

NOTE: *Environmental investigations under the Environmental Appraisal Program to provide means of validating assessments through monitoring of project activities.

Table III-3

SUMMARY

ADAPTIVE ASSESSMENT METHODOLOGY

Objectives	Process
Pre-construction:	
1. Develop perspective on relationships, by area, between physical disturbances, management plans, environmental resources.	Assemble team of experts.
- Identify set of environmental studies - Identify effects of physical disturbances - Identify broad ecological view - Identify geographic area	"Bounding", systematic compression of large number of variables into an organizable framework.
2. Develop descriptive and analytic methodologies, assessment strategies, and management outlines.	Matrices and computerized spatial analysis system.
3. Develop assessments of anticipated impacts and identify parameters to be monitored.	Analysis of information from 2 above.
4. Provide adequate information for the preparation of Evironmental Impact Statements (EIS's).	Use assessments from 3 above.
5. Write, circulate, and file EIS's containing monitoring plans.	CEQ and Agency guidelines and Regulations
Operations and Maintenance:	
1. Implement monitoring programs with improvement to focus on environmental studies: to provide early warning, redirection, management options.	Compare frameworks to identify and interpret change.
2. Impact prediction analysis: <u>where</u>, <u>when</u> (impacts), <u>what</u> resources affected, <u>how</u> impact would occur, and <u>what</u> consequences would be.	Computerized spatial analysis system.
3. Determine what change is needed.	Agency coordination and public review of alternatives.
4. Make the needed changes in operation, construction, or system management.	

IV. AFFECTED ENVIRONMENT

4.01 The region considered under the Navigation Season Extension Program is the Great Lakes System. This System, the five Great Lakes and their connecting waterways and the St. Lawrence River, constitutes the greatest continuous mass of fresh water on the face of the earth and produces a vast supply of fresh water, fish and wildlife, and other resources, while providing a livelihood and recreation for millions of people each year. This livelihood is enhanced by the network of navigation channels in the system. These navigation channels consist of 2,342 miles of water highway from the heart of the North American continent to the sea via the St. Lawrence River. Of this, 1,270 miles are within the Great Lakes. The remainder is along the St. Lawrence River. Approximately 1,000 miles of the distance is below Montreal, Canada, which is the head of deep draft ocean navigation.

Historical Perspective of Navigation on the Great Lakes System

4.02 In 1887, the average size vessel passing through the canal at Sault Ste. Marie was 600 tons and the total cargo moved was 5,000,000 tons. By 1924, vessel size had increased to 3,000 tons and total cargo movements were nearly 50,000,000 tons. In 1970, total cargo movements were more than 100,000,000 tons and average vessel cargo per passage was 7,400 tons. In the 1972 season, a 1,000-foot long self-unloading carrier, capable of carrying up to 58,000 tons of iron ore and loading and unloading as much as 10,000 tons per hour, began operating on the Lakes.

General Description of the Great Lakes Basin Dimensions

4.03 The total area of the Great Lakes Basin, both land and water, above the easterly end of Lake Ontario, is approximately 296,000 square miles, of which 174,000 square miles are in the United States and 122,000 square miles are in Canada. The dimensions of the basin are approximately 700 miles in the north-south direction and 900 miles in the east-west direction. Figure 3 shows the Great Lakes Basin/St. Lawrence Seaway in its entirety.

Topography and Geology

4.04 The Great Lakes, with their outlets and existing lake levels formed by glacial activities, date back less than 3,000 years, with the subsequent processes of stream and shoreline erosion making only slight changes in the original topography. All the Great Lakes are interconnected by the following channels: St. Marys River connects Lake Superior and Lake Huron; Straits of Mackinac connects Lake Michigan and Lake Huron; St. Clair River, Lake St. Clair and Detroit River form the connecting channel between Lake Huron and Lake Erie; and Niagara River connects Lake Erie and Lake Ontario. The Great

Lakes are connected to the Gulf of St. Lawrence by 557 miles of the St. Lawrence River, of which 125 miles are in the International Sector.

Human Environment and Resources

4.05 The physical environment of the Great Lakes Basin has exerted a strong influence over the level and distribution of population, as well as the type and distribution of economic activities. The single most significant resource is the five Great Lakes and connecting channels. This source of water, in addition to abundant natural resources and large agricultural potential, has allowed a highly industrial and agricultural area to develop. The United States portion of the Basin contains one-seventh of the Nation's population and four percent of the total U.S. surface area and produces one-sixth of the national income. The Great Lakes Basin has contained 14 to 15 percent of the United States population over the period 1950 to 1975. Within the Canadian portion of the Basin, the importance is even greater. The Ontario portion alone contains almost one-third of the total population of Canada and produces nearly one-third of the national income. If the Canadian portion of the St. Lawrence River Basin is included, then the proportion of total population and economic activity rises to over 60 percent of the Canadian national total.

4.06 Approximately eight percent of the 29.3 million residents within the Basin are located within urban port areas along the shores of the lower Great Lakes. Major urban developments include Milwaukee, Wisconsin; Chicago, Illinois; Detroit, Michigan; Cleveland, Ohio; and Buffalo, New York.

4.07 Production. The Great Lakes Basin economy is basically industrial, utilizing the transportation and power advantages offered by the Great Lakes-St. Lawrence River system. In addition, there is significant agricultural, mining, and forestry production. Commercial fishing, historically one of the oldest activities, has declined in commercial importance, although sport fishing has increased significantly and is of great economic importance to some regions.

4.08 Economic activity is greater and more intensive in the United States portion of the Basin, but the proportion of total Canadian activity in the Basin, compared with the national total, is much higher. The economic-industrial structures are generally similar in the two countries, with some important differences in the relative share of some industrial groups.

4.09 Population and economic development result in increasing and competing demands upon the lands and waters of the Great Lakes and their connecting channels. Industry, commerce, residential

development, recreation, mining, public buildings and lands, transportation, and navigation, could result in demands that decrease agricultural, forest, and open space for public use.

Significant Resources

Water Levels

4.10 The levels of the Great Lakes are a result of an integration of all of the hydrologic factors which affect the land and lake surfaces of the Basin as well as the hydraulic characteristics of the connecting channels and the St. Lawrence River. Lake level is the characteristic of the lakes which most frequently affects man's use of these waters, since it controls the shoreline use, navigation, and the amount of hydroelectric power which can be produced in the connecting channels and outlet river.

Water and Air Quality

4.11 Many Federal, State, and local programs exist for the purpose of maintaining or enhancing water quality in the Great Lakes Basin. The Federal programs are primarily the responsibility of the United States Environmental Protection Agency (EPA) established by Reorganization Plan No. 3, effective 2 December 1970. A discussion of the various air and water quality programs and criteria is found in Appendix F.

Fisheries Resources

4.12 The Great Lakes Basin contains more than 237 kinds of fish (species and sub-species), which represent most of the important families of fresh water fishes in North America. Most of these species are indigenous to the Basin, having entered the lakes during the last glaciation (the Wisconsinan) period. During the development of the Great Lakes System, there existed a water connection between the lakes and the following drainages: Hudson Bay and Upper Mississipps River; the Ohio and Middle Mississippi Rivers; and the Mohawk, Hudson and Susquehanna Rivers. In addition, exotic species are present, having been either purposely or inadvertently introduced by man. These introductions, along with past fishery management practices, have led to significant changes in the fisheries resources of the Basin. One example is that of the sea lamprey which entered the Upper Great Lakes through the Welland Canal. This fish has had one of the largest adverse impacts on the fisheries of the upper lakes.

Wildlife Resources

4.13 There are over 400 species of birds and 78 kinds of mammals in the Great Lakes Basin. Upland game birds found in the Basin include ring-necked pheasants, ruffed grouse, quail, and turkey. Waterfowl

include several species of geese and many species of ducks. Typical shore and marsh birds include bitterns, rails, herons, loons, red-winged blackbirds, gulls, and terns. Common non-game birds include hawk, owls, and many species of songbirds. Endangered bird species in the basin include the American peregrine falcon and arctic peregrine falcon (migratory only), Kirtland's warbler, and bald eagle.

Biological Zones

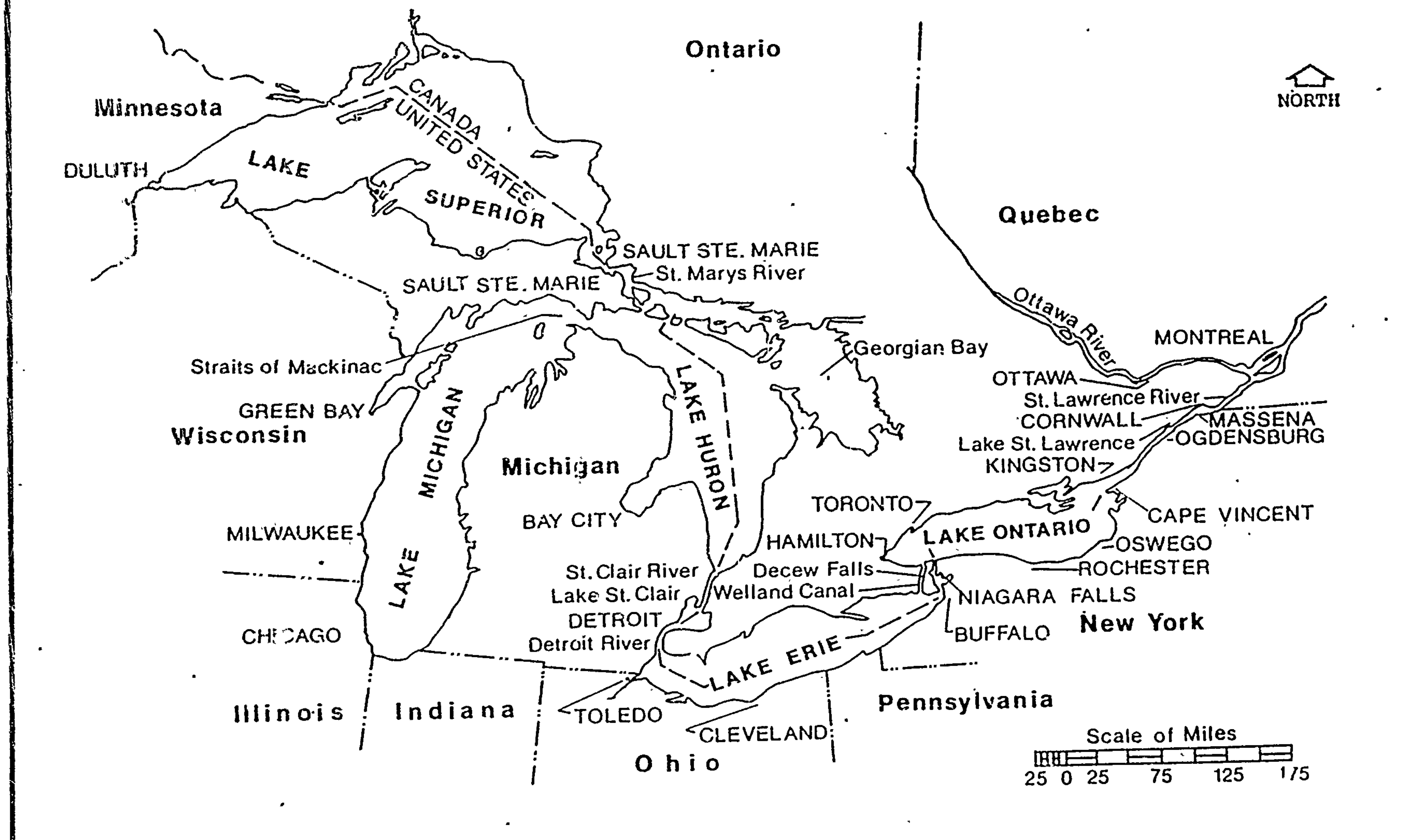
4.14 Shorelands comprise some of the most unique ecosystems in the Great Lakes Basin. The shoal water and the shoreline, with its characteristic flora, support a diversified and extremely significant fauna. Successful components of an individual shoretype environment are the dune grasses of the lake sands; the cedar, juniper, and hardwood of the Huron shore; the cattails and rushes of Green Bay, Saginaw Bay, and Lake Erie; and the stunted pines, hardwoods, and rock outcrops of Lake Superior. Some 245,000 acres of bottom consisting of hard-packed sand, gravel, and ledge rock, subject to wave wash and scour, provide a minimum wildlife value. Shallow waters are classified as primary or secondary according to their value as habitat for aquatic plants and animals, based on its physical environment. There are approximately 295,000 acres classified as secondary shallow waters (2).

Transportation

4.15 The region occupies a location strategic to the highly industrialized and well-populated north central United States and south central Canada, and is astride the transcontinental link between the major agricultural production regions of the west and midwest and the markets for these goods in the east. The Great Lakes-St. Lawrence Seaway system provides 27-foot deep navigation channels from Duluth-Superior to Montreal and 35-foot channels from Montreal to Quebec City. Over 100 billion ton-miles of waterborne freight are carried by this system each year. The area also has major rail, highway, and airline systems.

Recreation

4.16 The Great Lakes Basin has 17.8 million acres of public recreational areas. There is a great diversity of outstanding natural features such as forests, meadows, marshes, shorelines, islands, streams, and lakes (both Great Lakes and inland). Many of these areas have exceptional scenic, wilderness, and aesthetic qualities which make them Nationally significant. Recreational resources are not evenly distributed, most being located in the drainages of Lake Superior, Lake Ontario, and the northern parts of Lake Michigan. Tourism reflects this uneven distribution in that most of the popular tourist areas are found in these drainage basins.



GREAT LAKES · ST LAWRENCE SEAWAY REGION

NAVIGATION SEASON EXTENSION

FIGURE 3

Social Characteristics

4.17 Social characteristics include the interrelated aspects of population, employment, income, and production. Significant characteristics with respect to the life-style of residents in the study area are as follows:

(1) The utilization of ferry service for cross channel transportation along the St. Marys River, the St. Clair-Detroit River area, and parts of the St. Lawrence River. When this ferry service to the mainland is inoperable on the St. Marys and St. Lawrence Rivers, during the winter months, island residents rely on the river ice cover.

(2) Commercial navigation employees maintain a seasonal life style of spring, summer, and fall employment with the winter months open for possible vacationing and/or recreational activities.

(3) Ice-related recreation activities are common throughout the system; however, predominant locations have been identified. These major activity centers are Cape Vincent, Wellesley Island, Chippewa Bay and Coles Creek along the St. Lawrence River; and Waiska Bay, Mosquito Bay, Brush Point, Big Point, Sugar Island on Lake Nicolet, Neebish Island on West Channel, Raber Bay, Lake Munuscong, and Maud Bay on the St. Marys River. Other major recreational areas on the Great Lakes include Muskegon Lake, Pere Marquette Lake, Grand Traverse Bay, Saginaw Bay, Sandusky Bay, as well as the island area in Lake Erie. Ice fishing, occasional ice boating, and snowmobiling are among the recreation activities which take plac in the winter months on the Great Lakes waterways.

4.18 Shoreline ownership (U.S.) is divided as follows: 133.1 miles (3.9%) Federal; 466.2 miles (13.4%) non-Federal public; and 2,871.3 miles (82.7%) private. A breakdown of shoreland use and ownership of each of the Great Lakes is shown in Table IV-1. Table IV-2 shows the land usage and ownership of connecting channels with the exception of the Straits of Mackinac which is included with Lake Michigan, and the St. Lawrence River which is included with Lake Ontario.

4.19 A projection of changes in shoreland use to year 2020 of the Great Lakes and their connecting channels indicates that: Industrial, Commercial, Public Buildings, and Lands will increase 39% with Lake Huron increasing the least (15%); Residential increase is projected at 30% with Lake Huron having the smallest increase (21%); Public Parks and Recreation shoreland will increase 17% with Lake Huron remaining unchanged; Fish and Wildlife shoreland will remain unchanged; and Agriculture, Forest, and Undeveloped shoreland will decrease 28% with Lake Ontario decreasing 85% and Lake Erie decreasing 100% by the year 2000. Table IV-3 shows the projected land use changes in miles and the percentage of change from present to year 2020.

TABLE IV-1
U.S. SHORELAND USE & OWNERSHIP
OF THE GREAT LAKES IN MILES

Shoreland Use	Superior	Michigan	Huron	Erie	Ontario*	Total
Residential	172.5	461.6	236.9	157.3	127.0	1,155.3
Commercial & Industrial	19.6	69.9	17.3	28.4	20.8	156.0
Agricultural & Undeveloped	40.2	280.6	84.7	68.2	109.9	583.6
Forest	599.0	350.0	181.0	4.4	0	1,134.4
Recreation (Public)	70.2	160.8	25.6	48.0	30.2	334.8
Public Bldgs. Related Lands	9.3	20.9	2.4	16.8	1.7	51.1
Wildlife Preserves	1.2	18.2	17.1	18.9	9.0	55.4
Ownership						
Federal	91.4	25.4	9.5	6.8	0	133.1
Non-Federal Public	87.0	219.9	56.4	71.0	40.9	466.2
Private	733.6	1,116.7	499.1	264.2	257.7	2,871.3
Total Shore Miles	912.0	1,362.0	565.0	342.0	289.6	3,470.6

*Lake Ontario includes St. Lawrence River within United States

SOURCE: Great Lakes Basin Framework Study

TABLE IV-2
U.S. SHORELAND USE
OF THE CONNECTING CHANNELS
IN MILES

Shoreland Use	Connecting Channels					Total
	St. Marys River	St. Clair River	Lake St. Clair	Detroit River	Niagara River	
Residential	19.8	25.9	36.1	5.1	4.2	91.1
Commercial & Industrial	4.5	8.7	1.9	19.0	6.6	40.7
Agricultural & Undeveloped	25.2	1.7	2.5	5.1	11.7	46.2
Forest	37.8	0	0	0	0	37.8
Recreation (Public)	0	0.7	2.1	1.8	8.6	13.2
Public Bldgs. & Related Lands	3.9	0	2.3	0	7.9	14.1
Wildlife Preserves	0	0	2.1	0	0	2.1
Total Shore Miles	91.2	37.0	47.0	31.0	39.0	245.2

SOURCE: Great Lakes Basin Framework Study

TABLE IV-3
PROJECTED LAND USE CHANGES
INCREASE OR DECREASE IN MILES & PERCENT
PRESENT TO 2020

Lakes

Land Use	Superior Miles	Superior %	Michigan Miles	Michigan %	Huron Miles	Huron %	Erie Miles	Erie %	Ontario Miles	Ontario %	Total Miles	Total %
Ind., Comm., Public Bldgs. & Lands	+42	+114%	+22	+24%	+3	+15%	+18	+30%	+5	+22%	+90	39%
Residential	+53	+28%	+115	+25%	+49	+21%	+62	+39%	+80	+63%	+359	30%
Public Parks Recreation	+13	+19%	+34	+21%	+0	0%	+4	+7%	+9	+30%	+60	17%
Fish & Wildlife Preserves	+0	0%	+0	0%	+0	0%	+0	0%	+0	0%	+0	0%
Agricultural Forest & Undeveloped	-108	-15%	-171	-27%	-52	-20%	-84	-100%	-94	-85%	-509	-28%

V. ENVIRONMENTAL EFFECTS

Significant Resources

Procedures of Identification of Impacts to Resources

5.001 Activities related to an Extended Navigation Season Program began during the winter of 1971-72 under the Demonstration Program. The goal of the Demonstration Program was to determine the practicability of various methods, both structural and nonstructural, to maintain extended season navigation on the Great Lakes-St. Lawrence Seaway System. Noted environmental impacts have been documented in several environmental statements for the Demonstration Program and in the 1976 Interim Feasibility Study.

5.002 The Interim Feasibility Study report states that the extended navigation season on the Great Lakes-St. Lawrence Seaway System is engineeringly and economically sound, with continuing environmental investigations recommended. The report recommends that a winter navigation program be adopted, comprised primarily of proven existing structural and nonstructural operational measures, to support a navigation season on the upper four Great Lakes and their connecting channels to 31 January (± 2 weeks).

5.003 The Interim Feasibility Report states that this extension (31 January, ± 2 weeks) should have no irreversible, unacceptable adverse environmental impacts. This was based on assumptions and observations made over the past several years of demonstration activities while such navigation had been occurring. However, the report and the Winter Navigation Board considered it necessary to continue environmental studies to document the validity of assumptions, observations, and conclusions reached with regard to the expected impacts and environmental feasibility. Therefore, an environmental appraisal program was proposed to accompany all program activities. Approximately $2 million was expended during the Demonstration Program to study what environmental impacts might be occurring. The assumption of "no unacceptable impacts" is based on those studies.

5.004 In January 1977 in support of the current Feasibility Report, the U.S. Army Corps of Engineers (COE) requested the U.S. Fish and Wildlife Service (FWS) take the lead in formulating an Environmental Plan of Study (EPOS) for the entire Great Lakes System (Great Lakes-St. Lawrence Seaway).

5.005 The FWS assembled five Environmental Planning Task Force Teams to identify concerns and needed studies. Citizens and scientists provided extensive input. The FWS completed the initial plan, termed the Interim Environmental Plan of Study (EPOS), in March 1978. The Interim EPOS included more than 400 environmental concerns and

studies suggested by scientists, Federal and State natural resource managers, private citizens and citizen organizations.

5.006 The COE and FWS determined that the Interim EPOS should be refined and developed into an Environmental Plan of Action (EPOA). The purpose of the EPOS is to aid in conserving the environmental attributes of the Great Lakes System, impacted by the Extended Season Program. The products of the EPOA would be reports describing the findings of the proposed studies and recommendations to eliminate or minimize the adverse effects of the project on the resources.

5.007 The assessments and studies outlined in the EPOA evaluate the impacts of the project on the natural environmental resources, both physical and biological, including fish and wildlife. The studies and assessments of the EPOA do not include the effects of the project on socio-economic aspects of the area, though these are impacted by the project and likely by the implemented recommendations of the studies. The socio-economic aspects interrelate with the natural environment by using the resources and by displacing them. The EPOA assessments and studies also do not include the institutional, cultural and aesthetic aspects of the project, though this aspect also interrelates with the natural environment.

5.008 The need for this environmental-engineering approach has been made apparent through the several years that the Extended Navigation Season Demonstration Program has been conducted. There does not exist any similar previous ice navigation programs of this magnitude which could be examined to learn of environmental impacts occurring in other systems. Reports on environmental research connected with ice navigation in previous projects are minimal. Because of the limited amount of biological research conducted in an ice environment, little is known about the aquatic ecosystem of the Great Lakes and St. Lawrence River during the late fall to early spring months.

5.009 On the other hand, eight years of an operational Demonstration Program on the upper Great Lakes have resulted in the finding of no generally agreed upon unacceptable adverse and irreversible environmental impacts associated with ice navigation. There exists a number of known, perceived, potential, hypothetical and known impacts, but little has been found that would warrant non-consideration of the program.

5.010 Phase I of the Design Studies. The function of the EPOA is to provide a definitive plan which would provide the environmental assessment data needed for a comprehensive evaluation of the extended navigation season program during post authorization planning design and other follow-on studies.

5.011 The development of a definitive plan is necessary because the current state-of-the-art does not permit a comprehensive evaluation.

This is largely due to deficiencies in technical information as related to existing environmental conditions, the degree and magnitude of foreseen or potential impacts, and the identification of impacts yet unknown. Therefore, the EPOA includes methods for assessing environmental impacts and a list of studies to be conducted. The EPOA would be refined throughout the Extended Season Program as new information and insights are gained.

5.012 Once the EPOA is implemented, this program of development would generate an information base from which more refined decisions on extended navigation could be made. Implementation of the EPOA under the Adaptive Method would provide a systematic approach to obtaining the data needed to assure environmental acceptability of the Extended Navigation Season Program. In other words, the objective is to develop an environmentally acceptable program or have no program.

5.013 The Adaptive Method approach during the survey stage consisted of the following actions:

1. Selecting an engineering plan subject to refinement to achieve year-round navigation.

2. Preparing a programmatic Environmental Impact Statement.

3. Developing an Environmental Plan of Action (EPOA), integrated with the engineering plan.

4. Initiating system-wide environmental studies in support of the survey study and follow-on studies.

5.014 The results of these efforts are an integral part of the survey report planning process and have been coordinated with the public, and Federal, State and local agencies prior to submission of the final Survey Report and programmatic Environmental Statement to the Congress for approval consideration.

5.015 Assuming Congressional authorization of a Federally assisted Extended Season Program, the project would then move into advance engineering and design phases prior to construction and operation. These are briefly described in the following paragraphs.

5.016 Post-authorization, Preconstruction Planning. The first step of the post-authorization and preconstruction process is advanced engineering and design (AE&D) which consists of three phases: Phase I General Design Memorandum (GDM), Phase II GDM and Feature Design Memoranda, and preparation of Detailed Plans and Specifications, are integrated with appropriate EIS's, as required. It is important to note that the post-authorization steps are standard courses of action

taken for any authorized civil works project. Project design becomes progressively more detailed and finalized in each phase of the process. The Adaptive Method approach will have a significant role in each phase as described below.

5.017 Phase I GDM. The objective of the Phase I GDM Program is to bridge the gap between the time when a survey report is completed and authorized and the initiation of detailed engineering and design of the authorized plan. During the authorization period, changes may occur that could affect the formulation of the authorized project plan and could change the authorized plan significantly. The Phase I GDM study seeks to identify, assess and evaluate changes in order that an affirmation or denial of the authorized plan can be made in light of current conditions and criteria, or a "reformulation" of the authorized plan may be made where these changes are significant.

5.018 Measures for implementing the EPOA, using the Adaptive Method technique, include the following management actions (see Table 7):

1. Early stage multi-discipline workshops: Key scientists, managers, policy makers, and resource leaders would identify and analyze the Great Lakes-Seaway system and develop assessment strategies and a management outline.

2. Data collection and refinement of current management plans and environmental studies: These would be used to identify effects of physical disturbances on the system and formulate broad ecological views of the system.

3. Computerized analysis system: This system would be used help to analyze relationships between physical disturbances, management plans and environmental resources within specific geographic areas, at various time periods. These relationships would be used to limit the scope of environmental assessment to significant factors affecting the target decision and would assist in identifying alternatives related to policy and actions.

4. Environmental studies: The Adaptive Method technique would identify specific parameters which could contribute to analysis and prediction in particular or general areas of the Great Lakes-St. Lawrence system. Studies would be designed in the following sequence: Survey studies, to determine general distribution and condition of environmental resources; Trend studies, to determine changes in distribution and condition; and Process studies, to determine causative linkages between changed environmental resources and the associated physical disturbances. This means of identifying studies which are needed would provide a means of prioritizing geographic areas of impact, resource values, and management actions that occur in each disturbance area. The object would be to make

early predictions to provide flexibility for making changes in proposed actions.

5. Monitoring: Actual impacts would be monitored during operations to provide information for identifying change and for adjusting policy and management actions.

5.019 Phase II GDM. After approval of the Phase I document, a Phase II General Design Memorandum would be prepared. The Phase II document would be primarily a functional design document in which detailed engineering design is accomplished.

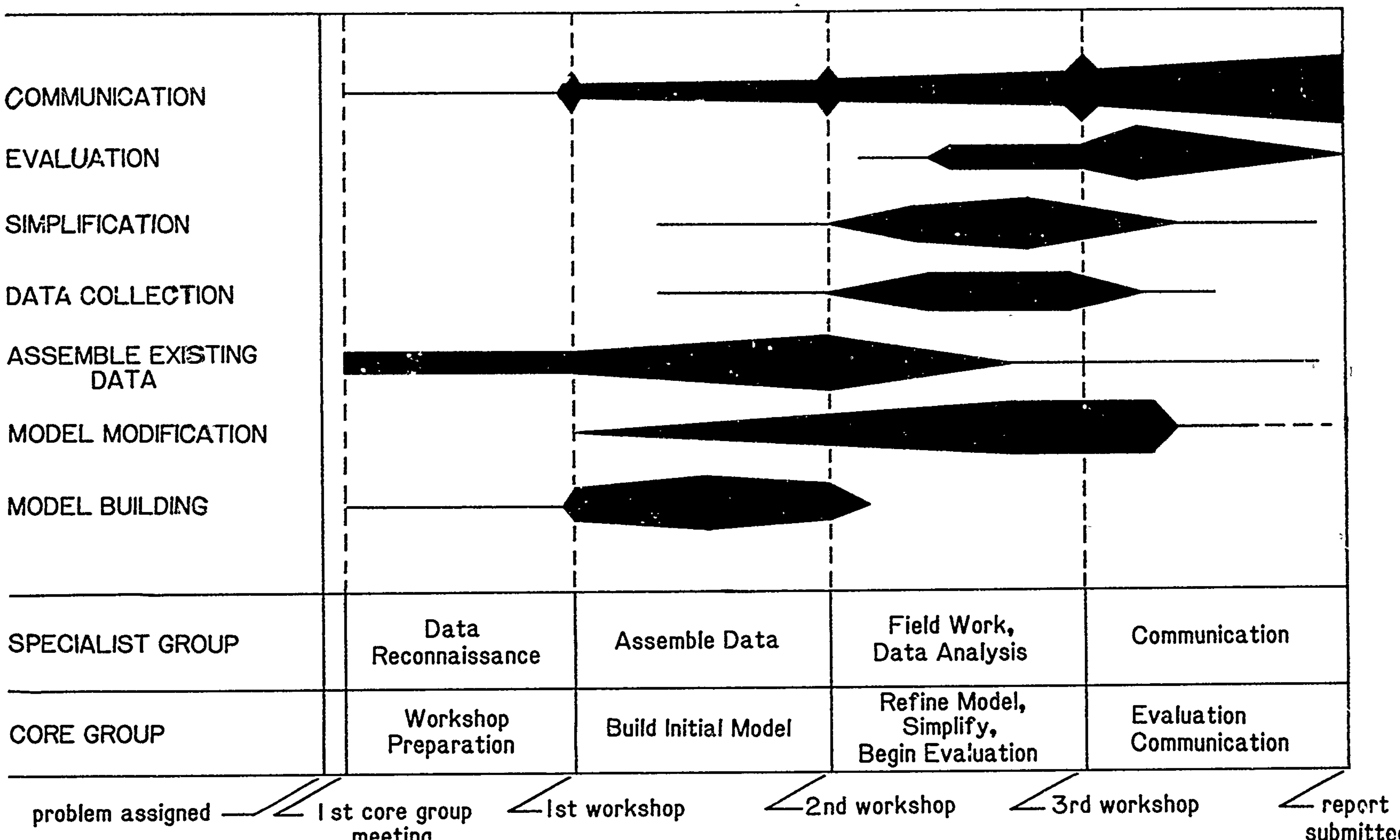
5.020 Activities under the Adaptive Method approach in this phase would continue to examine baseline studies conducted in Phase I. While no new formal environmental impact statement would necessarily always be completed an archaeological reconnaissance is required, and design details would be sensitive to specific environmental and social concerns surfaced after the last formal EIS, with the Phase I GDM. Should the design be changed significantly or new information come to light revealing potential for previously unrecognized impacts, a new EIS would be prepared as required by regulations.

5.021 After approval of the Phase II General Design Memorandum, specific project feature design memorandums would be prepared for each major element of the project. Each of the feature design memorandums would, where practicable, include sufficient design data to establish the interrelationship between engineering, environmental, and other design aspects of the particular feature. Following this step, detailed plans and specifications would be prepared on the specific project features to enable construction of the project.

5.022 Post-authorization - Construction/Operation. During the construction and operation stages of the program, the emphasis of environmental effort would transform from establishing baseline conditions to monitoring of "with" project conditions. This monitoring effort would provide a means for determining whether or not the impact predictions were correct and no unacceptable adverse impacts are or would occur with continued operations. Due to the flexible response to environmental concerns as part of the Adaptive Method approach, actions during construction and operation stages would be sensitive to any adverse project induced changes identified by the monitoring effort.

5.023 The monitoring effort would culminate in the final evaluation or validation report. It is at this validation point that the overall project would be evaluated in light of project induced changes, an evaluation report prepared, and the report subsequently provided to the Congress for its information.

TABLE V-1



Activities and Relative Time Periods for the Adaptive Environmental Assessment Methodology

5.024 In summary, the Adaptive Method approach would provide the mechanism, in concert with the advance engineering and design, and construction and operation phases of the project, for a sequence of information gathering, impact predictions redress assistance, and monitoring to further evaluate and assess impact predictions of implementation of an operational winter navigation program. Through the Adaptive Method, construction and operation would not proceed until adequate environmental assessments and statements have been completed during the pre-construction phase. In addition, the adaptive response mechanism would provide, when and where necessary, for modifying construction/operation activities to reduce or eliminate unacceptable impacts identified by proposed monitoring programs. Results of the Adaptive Method approach would be culminated into an evaluation report and provided back to Congress.

5.025 This section examines the environmental impacts currently known, perceived, or considered potential and areas of environmental concerns for which sufficient information is currently unavailable.

5.026 Environmental concerns and impact analysis are addressed as to what effect the total recommended program could have on each environmental component category, rather than independently analyzing each program activity and its associated environmental impacts. Separate Environmental Impact Statements (EIS), Environmental Supplements, Environmental Assessments (EA), or Clarifications Statements, would be prepared as appropriate for each of the individual activities, if significant changes are identified. The approach being utilized would permit the reader to assess how and to what level or degree the individual activities could affect or impact on various environmental components; and to identify, and evaluate foreseen impacts or concerns within the respective environmental components.

5.027 For example, impacts and concerns expressed, relating to operation of a bubbler system could include: increased oxygen levels and the resuspension of bottom sediments. These impacts might or might not occur. This is discussed under Impacts on Water Quality. Concerns have been expressed that operation of the bubbler system might alter fish movements. Also, if open water is created in the ice cover, its effect on water birds is a concern. These concerns would be addressed under Impact on Fisheries, and Impact on Wildlife, respectively.

5.028 Following is a brief description of possible impacts and environmental consequences of the project plans on the physical, biological, and socio-economic resources of the Great Lakes/St. Lawrence Seaway. A more detailed discussion of these impacts on the resources can be found in Appendix F.

Physical Environmental Resources

5.029 Water. The water resources of the Great Lakes System play an important role in the life-style of the Great Lakes region. Not only does the 95,000 square miles of surface area provide a 2,342 mile waterway route, its waters provide a focal point for fish and wildlife recreation, social life-style, and industry. Factors of water resources, such as water quality, and levels and flows, greatly affect the Great Lakes Basin.

5.030 The water resources of the Great Lakes System could, to varying degrees, be affected by activities proposed under the extended navigation season program. Such activities include: dredging, dredge material disposal in open water, winter navigation/icebreaking, construction of shore erosion and shore protection measures, the installation or modification of ice booms and aids to navigation, and the construction and operation of water compensating works.

5.031 Considered dredging activities on the St. Marys River consist of the removal of 3 million cubic yards of bottom sediments along 17 miles of the Middle Neebish Channel. Dredging activities in this river could alter, in a localized manner, existing hydraulic conditions, such as current patterns, velocities, and flow distributions. However, because of man-made and natural controls that regulate the flow through this waterway, the proposed dredging would not affect the upstream water levels of Lake Superior, the downstream water level of Lake Huron, or the total flow in the St. Marys River.

5.032 Dredging and disposal of material (if required) and major in-water construction activities, which temporarily increase the dissolved solids in the water, could alter water quality by suspension of bottom sediments. These activities could also influence biota by increasing nutrient levels through resuspension, possibly causing an increase in the Biochemical Oxygen Demand (BOD), and resuspension of toxic materials (if present) into the water column.

5.033 Dredging and construction of permanent in-water facilities could also alter local current patterns, flows, and velocities. Unless properly designed, these variations could result in undesirably altering the area's hydraulic conditions causing changes in sedimentation rates and distribution, flushing time, ice formation, and shoreline and bottom scour in the general vicinity. These impacts may either be adverse or beneficial depending on details of construction.

5.034 Though for "clean" sediments open water disposal is common practice, such disposal could result in degraded water quality including an increase in the Biochemical Oxygen Demand (BOD),

turbidity, with consequent reduction of light necessary to plant life, smothering of living organisms, and blanketing of the bottom through sedimentation, (interfering with biological cycles).

5.035 Construction of the proposed compensating works, offshore navigational aids, and the installation of the bubbler systems could have similar impacts on water quality. These impacts would include increased turbidity and depressed dissolved oxygen levels, a result of the resuspension of organic substances, chemicals, and other oxygen demanding substances. These influences are perceived to be temporary in nature with relatively little overall significance. During construction, measures would be taken to minimize the effects that such activities would have on water quality.

5.036 Impacts on water quality, relating to operation of a bubbler system could include: increased oxygen levels and resuspension of bottom sediments. These impacts may or may not occur, depending on the many variable factors present at the site including type of bottom material, current velocities in the area, and existing oxygen levels.

5.037 Another possible impact on water quality, associated with winter navigation, is the impact of blackwater (human body wastes) and graywater (non-human wastes) discharges from vessels.

5.038 Two studies were conducted and reports were prepared to assess the effects of navigation season extension on blackwater and graywater waste disposal generated onboard Great Lakes commercial vessels. The report determined that navigation season extension:

a. Was not seen to have a serious impact on shoreside disposal facilities.

b. Would have little effect on shipboard marine sanitation devices (MSDs).

c. Was found to have negligible long-term effects.

d. May cause adverse conditions, in the short-term, especially in harbors and sensitive coastal environments.

e. Was not seen to create substantial economic penalties for shipowners due to the addition of MSDs.

5.039. Air. Air quality is a highly variable factor of the environment. Large changes occur within short distances due to population and industrial centers and natural physical processes. Within the Great Lakes Basin, air quality varies from clean, in the more remote regions, to poor in areas of high industrial

concentration, such as Duluth, Minnesota; Detroit, Michigan; Gary, Indiana; and Chicago, Illinois.

5.040 Transportation and fuel combustion on the Great Lakes influences the regional air quality. Commercial vessel operation, which includes loading and unloading activities, is a source of air contamination.

5.041 Other possible sources of air contamination associated with an extended season include: Construction, dredging, and equipment operation as proposed for the project. However, due to the short-term nature of these activities it is anticipated that these adverse air quality impacts would be temporary.

5.042 The implementation of the proposed Navigation Season Extension plan could alter the pattern of atmospheric loading on a local, as well as a regional, basis. As vessel traffic expands over a twelve month period and the work effort is increased in order to ply the waterways, as would be experienced by navigation through ice (including icebreaking operations), levels and distribution of emissions to the atmosphere could be affected. With an extended season for shipping, any seasonal recovery of air quality that may have been associated with a non-shipping winter season could be somewhat reduced.

5.043 It is difficult to accurately assess the actual impacts that winter navigation could have on air quality. The factors to consider would include those associated with vessel operations, atmospheric conditions and the location of project activities. The impacts perceived at present should not significantly alter the air quality of the region.

5.044 <u>Shorelands</u>. Concerns have been raised that navigation in an ice environment may contribute to erosion of shorelines and sediment transport, two naturally occurring phenomena. In order to analyze the role of ice and winter navigation in sediment transport and shoreline erosion, the Cold Regions Research and Engineering Laboratory (CRREL) of the Corps of Engineers, identified erosion prone areas within the Great Lakes, their connecting channels, and the St. Lawrence River that could be created or accelerated by winter navigation. Areas of concern icluded the direct movement of ice in contact with vessels, propeller wash, drawdown and surge, dredging, and ice control structures (ice booms, etc.). The significance of these various factors depends on a number of local conditions, ice conditions, and the presence of other transport agents (e.g., natural currents or waves).

5.045 The role of ice and cold temperatures in sediment transport and shoreline change has many facets. Ice formed on a shore or riverbank may isolate and, thereby, protect the soil. Ice formation

can, however, cause significant localized shoreline damage by gouging ordinarily stable beach or bank formations, removing protective vegetation, by freezing sediment at the ice-soil interface and by entrainment of sediment within the ice structure. In addition, ice cover could alter and even amplify the effects of navigation on system hydraulics and sediment transport.

5.046 A reach of shoreline could be affected over a period of years, but only a small portion of such a reach may be affected in any one year. Mitigative measures, such as vessel speed restrictions and/or shore protection, are being considered; a discussion of which can be found in Plan Formulation - Appendix B.

5.047 Large scale navigation during the winter ice season exerts a major influence on river hydraulics. In addition, vessel passage and icebreaking activities, which "pack" broken ice under surrounding ice cover, further constrict the river cross section and could amplify ship-induced disturbances.

5.048 Another possible impact could occur with draw-down and surge waves. Ship-induced water level surges can cause the ice to break at or near the shore and possibly allow sediment-laden water to spray out onto the ice cover. Associated with this sediment has been benthic organisms, aquatic vegetation, and fish. A preliminary survey was conducted to study the effects of these surge waves on the benthic community, fisheries, and physical aspects of the environment. Results were inconclusive and concerns remain. A summary of this study can be found in Appendix F.

5.049 By Federal definition, the Great Lakes Coastal Zone includes all submergent lands, waters and islands of the Great Lakes and connecting waterways, as well as the inland resources and resource using activities which influence or are influenced by the coastal area in a significant direct fashion.

5.050 In order to provide effective protection and economically and environmentally sound development of coastal zones, Congress passed the Coastal Zone Management Act (P.L. 92-583) of 1972. The Act was substantially amended on July 26, 1976 (P.L. 94-370). The Act and the 1976 amendments provide assistance and encouragement to coastal states to develop and implement rational programs for managing coastal zones through grants made by the Department of Commerce.

5.051 Once an approved State program is in effect, every applicant for Federal license or permit for an activity in the coastal zone must furnish a certification from the State that the proposed activity complies with the State's coastal zone management program. Therefore, coordination with the State coastal offices is necessary for all projects which may affect the coastal zones, including the navigation season extension program. The program may affect the

following areas concerning State's coastal zone management:

a. Sensitive shoreline areas along the coastal zone (erosion and flood prone areas, wetlands, sand dunes, and islands).

b. Historic and archaeological sites.

c. Recreation areas.

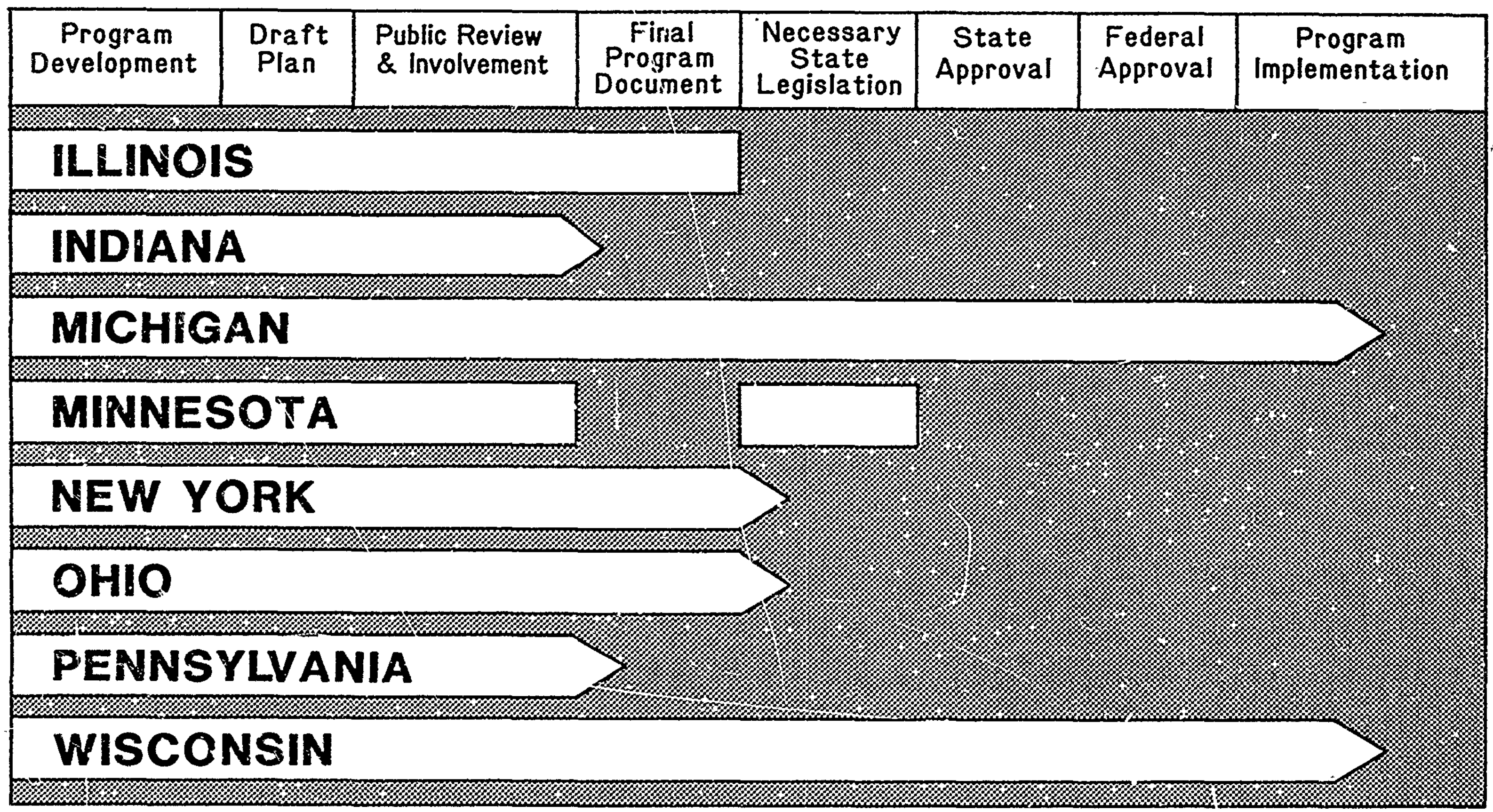
d. Port and harbor areas (intensive use areas, coastal lakes, river mouth, bays, urban areas).

e. Water and air quality issues and effects.

f. Transportation of oil, natural gas, and hazardous substances.

5.052 In this pre-operational phase of the project, since adequate environmental baseline data and impact assessments are not available consistency with individual states' CZM programs cannot be determined. However, under the Adaptive Methodology, the impacts on specific coastal areas would be assessed once they were identified in the detailed plans and specifications. A detailed discussion of these plans is located in Appendix F and the Main Report and will be used in the Adaptive Methodology as a factor for management. Currently only two of the Great Lakes states (Michigan and Wisconsin) have an approved CZM program. For the present status of all eight Great Lakes states CZM programs, see Figure 4.

June 1979 Status of Great Lakes Coastal Programs



In general, the states completed the process in the order depicted on the graph, there have been variations and overlapping of different stages. Also, the graph does not reflect the time involved in completing particular parts of the process since this varied from state to state.

From <u>Great Lakes Communicator</u>

FIGURE 4

Biological Environmental Resources

5.053 The proposed Navigation Season Extension Program would cause environmental impacts on biological communities within the Great Lakes Basin. The impact could be incurred through icebreaking, vessel movement, construction activity, dredging, bubbler system operation, and water and ice control structures. Open deep water areas of the Great Lakes are not foreseen as being significantly affected. The greatest concentration of impacts would occur in the nearshore zones and connecting channels in the vicinity of program activities. Within these two types of areas, fish, wildlife and their habitats could be affected. Habitats sensitive to the proposed program activities include littoral zones, coastal wetlands, shoal areas of the connecting channels and harbors, and fish refuges. Therefore, impact discussion will mainly center on these sensitive areas. The effects on these habitats are important because fish and wildlife rely on these areas year-round or during some stages of their life histories.

5.054 Wetlands. Certain sensitive habitats in the Great Lakes basin could be impacted more than others. Areas that may be of particular concern for endangered or threatened species are the coastal wetlands. In Michigan, wetlands are known to be the habitat of 38 percent of the State's endangered plant species (3).

5.055 Vessel operation and icebreaking have potential to disrupt nearshore habitats; i.e., wetland fringes such as those in the lower St. Clair River and shoals of Bois Blanc, Round, and Mackinac Islands, and those adjacent to the channels of Saginaw Bay, Alpena Harbor, Sandusky Bay, Peach Island, and Grosse Ile (St. Clair and Detroit Rivers) (4).

5.056 Ice jamming, if unmonitored or not acted upon, in constricted areas or bends of the connecting channels could result in flooding. To mitigate this problem, ice booms are proposed for certain areas of the waterway in order to decrease the amount of ice flowing through constricted areas and reduce the possibility of ice jamming. Flooding could still occur and sensitive shoreline habitats could be affected by fluctuations of water levels and the local increase of ice thickness; particularly if no monitoring is accomplished and no action is taken. Existing operation monitoring plans have helped prevent such occurrences during the Demonstration Program.

5.057 Benthic Communities. Activities which would affect benthic communities (communities of organisms attached or resting on the bottom or living in bottom sediments of a river or lake) are: dredging, vessel operations (including icebreaking), bubblers, construction of shore protection measures, and the installation of ice booms and navigation aids.

5.058 The most pronounced effect that the above stated activities have individually, or in combination with other activities, are the removal/disruption and suspension of bottom sediments, including benthic (bottom dwelling) organisms.

5.059 The use of riprap for shoreline protection and in water for structure protection could alter the aquatic habitat. Initial placement of riprap or other similar material would eliminate some benthic habitat, but new habitats would be created. These "new" habitats would arise from the increased surface area of the riprap and the interstitial space between individual components of the riprap. The additional surface could provide a base for primary productivity, the base of the food chain. The spaces established would be available to young fish as protective cover and feeding areas.

5.060 Dredging operations would physically alter the sediment-water interface in these areas of dredging. This effect could impact on benthic communities by either destroying, removing or displacing benthic organisms. Recolonization would be expected, but a portion of the total available food supply for fish would be lost for part of two years.

5.061 In addition, it has been theorized by the U.S. Fish and Wildlife Service that dredged commercial navigation channels could be serving as dispersal routes or places of refuge for mobile benthic organisms during periods of extreme cold weather. Passage of vessels during such times could dislocate these organisms, resulting in a high rate of mortality and causing a significant drop in aquatic food production for fish. Impacts of such an occurrence would not be immediately noticeable but could show up in reduced production or in reduced species diversity several years in the future.

5.062 Proposed program activities which create open water or provide for areas of thinner ice cover could influence the periphytic communities (community of organisms, both plant and animal, attached or clinging to surfaces projecting above the bottom). This influence, e.g., light penetration and possible local water temperature changes, is considered as not having a significant adverse impact on the community due to proposed program activities.

5.063 Removal of bottom materials during the dredging process would result in elimination of immobile benthic organisms and rooted aquatic plants from the dredged area. Consequently, some reduction in the food and protective cover available to resident fish and wildlife populations would occur and would represent an unavoidable impact upon the productivity of the aquatic system. The loss of productivity during this disturbance would be irretrievable to the ecosystem.

5.064 The fisheries resource of the Great Lakes System could locally be affected through the program activities in areas such as connecting channels, harbors, and shallow water areas of lakes by influencing fish spawning, including egg survival, behavior, distribution, and habitats. These project-related activities include vessel operations, propeller wash, addition of riprap, dredging, dredge material disposal, construction of navigation aids and compensting works, icebreaking, and operation of the bubbler system which might alter fish movements.

5.065 Vessel operations and icebreaking have the potential to physically disturb bottom areas used for feeding, cover, and predation. This could impact the overall fishery resource of the affected areas, both commercially and recreationally. It is not currently possible to quantify this potential impact, and it may or may not be significant. In addition, fish mortality could occur as a result of vessel induced waves.

5.066 Propeller wash, vessel movement, and dredging activities could increase turbidity and suspended sediments. This turbidity could reduce the field of vision of sight feeding fish and impair respiration of aquatic organisms in the immediate area through the clogging and plugging of the respiratory membranes. Respiration impacts normally occur only in cases of extreme turbidity immediately adjacent to the activity causing the disturbance. Turbidity problems of this type would be of relatively short duration under the proposed program.

5.067 Siltation by resuspended sediments could eliminate some submerged vegetation habitats used by fish for feeding, cover, and resting areas. Gravel spawning beds could also be buried by this sediment if any are located where sedimentation would be increased. This would reduce the value of such an area for spawning.

5.068 Icebreaking could create underwater ice irregularities in shallow water which could, in turn, affect local water circulation and limit fish movement.

5.069 Dredging activities could cause fish to migrate to surrounding undisturbed areas. This displacement could increase stress on adjacent habitats. If dredging activities are conducted during fish spawning periods, they could adversely affect spawning and egg maturation by removal as well as disruptive disturbances. Scheduling of program activities during non-spawning times or in areas not associated with such biological activity would alleviate the impact that dredging and disposal would have on the aquatic environment. Studies on the potential impacts of dredging on fish are recommended in the EPOA (see Appendix E). Impacts would be determined in advance of construction and mitigative measures taken accordingly.

5.070 Two fisheries studies were conducted on the Great Lakes/St. Lawrence Seaway to identify impacts from the Winter Navigation Demonstration Program. These site specific studies examined such things as species diversity and abundance, both fish and plankton, feeding behavior, habitat, and physical measurements of the St. Lawrence and St. Marys River fisheries. These sites were chosen because of the concentration of vessels in these narrow channels, and the sensitivity of the environment, biotic, physical, and recreational. No substantial conclusions were able to be made on the St. Lawrence River study due to the fact that the fisheries of the St. Lawrence River are dependent on a interrelated set of parameters which, due to their complexity, were not all monitored (5).

5.071 The St. Marys River fisheries study (6) also tried to locate the spawning grounds of the lake whitefish Coregonous clupeaformis, and the lake herring Coregonus artedii, and determine the amount and classification of sediment deposited on these spawning grounds. Results showed as much as a fifty fold increase in the amount of material suspended in certain segments of the river with Winter Navigation than without. Difficulty was met with the recovery of the eggs, so consequently no substantial conclusions were able to be made. It was noted that sedimentation during spring breakup was greater than that observed during vessel transits. Abstracts of these two studies are found in Appendix F.

5.072 Wildlife. Wildlife within the Great Lakes Basin could be impacted by the Navigation Season Extension Program. These impacts would occur in the coastline area where the project-related activities occur. As previously mentioned, the areas of major perceived impact are the shoals, littoral zones, and coastal wetlands of connecting channels and harbors. Much of these areas is good wildlife habitat and is valuable for wildlife movement, migration, and breeding.

5.073 Wildlife breeding could be affected by the recommended program through the loss of breeding habitat. Construction activities, dredging, and vessel operation could eliminate, degrade or enhance the breeding value of certain areas. Of main concern are emergent wetlands and shoals, perceived as vulnerable. Loss or alteration of these important habitats due to physical changes by project activities could lead to decreased production. This could, in turn, affect the ecology and economics of nearby areas by decreasing the number of animals present which could decrease trapper catches, for example. Associated displacement of wildlife by upland disposal could stress adjacent wildlife populations and habitat as well. Disposal sites would be selected to minimize such adverse impacts. Open water could be created or altered by icebreaking activity associated with the program, which includes U.S.C.G. icebreaking activities and commercial vessel traffic in an ice environment.

5.074 Vessel traffic, in general, could also aggravate ice conditions by breaking the static ice packs and causing continual encroachment of ice packs into the winter feeding areas, thereby reducing the available feeding area. It is this restriction to waterfowl usage that, over a period of time, could cause malnutrition in waterfowl.

5.075 Also, if open water is created in the ice cover, its effect on water birds is a concern.

5.076 The loss of existing terrestrial vegetation as a result of dredge disposal on land is an irretrievable loss of present habitat and, without proper planning, might provide an irreversible stress factor to present wildlife population inhabiting the surrounding areas and dependent on the fill-site. Such impacts may be reversed over a long period of time.

5.077 Excessive siltation and improperly located open water disposal of dredge material could adversely affect aquatic organisms by impairing respiration and growth of attached algae and rooted plants.

5.078 Actual impacts on fish and wildlife, resulting from a program such as Navigation Season Extension, are poorly understood. In-depth studies would be required to determine the short and long-term changes on the biota and their habitats. The Environmental Plan of Action (EPOA), a joint effort of the Corps of Engineers and the U.S. Fish and Wildlife Service, has suggested a total of 132 studies, of which 122 are site specific and 10 are system-wide. These studies would explore the effects of the project activities, the need for protection of certain areas, and the need for mitigation of habitat losses, and ways to provide environmental benefits and enhancement as part of the project. Results of these studies would provide a solid basis for evaluation of impacts.

5.079 Vegetation. Significant impacts of the proposed program on vegetation appear unlikely over large areas of the Great Lakes System, but perceived impacts could occur within constricted areas of the system, such as in connecting channels with aquatic vegetation, both submergent and emergent, incurring most of the impacts in localized areas. These areas could be identified in studies listed in the EPOA. These activities include icebreaking and vessel operation causing disruption of shoreline and wetland vegetation, affecting primary productivity, as well as construction operations and dredging; possibly eliminating submergent growth, impairing growth or resulting in death of plants, and possibly impacting aquatic fauna through the loss of habitat or food chain production.

5.080 Construction of shore based aids to navigation; e.g., course ranges, would have a minimal effect on terrestrial vegetation.

5.081 Loss of vegetation could also occur with the construction of required support facilities. Removal or burial of upland flora could result for individual projects.

5.082 Dredged material disposal at an upland site could also result in temporary destruction of vegetation and upland habitats in and around the disposal site(s). Unless properly planned, disposal could eliminate forage material and cover for wildlife.

5.083 Endangered or Threatened Species According to the Federal Register containing the list of Endangered and Threatened Wildlife and Plants (January 17, 1979), there are 20 endangered and/or threatened species found within the Great Lakes/St. Lawrence Seaway area. The following is an abbreviated list of these species. A complete listing from the January 17, 1979 Federal Register is located in Appendix F.

bald eagle[1]	Halialetus leucocephalus
gray wolf (timber wolf)[2]	Canis lupus
Indiana bat	Miotis sodalis
Kirtland's warbler	Dendroica kirtlandii
longjaw cisco	coregonus alpenae
white cat's eye pearly mussel	Epioblasma sulcata delica
northern wild monkshood[3]	Aconitum noveboracense

[1]Threatened in Minnesota, Wisconsin, and Michigan, Endangered in Ohio, Illinois and Indiana.

[2]Threatened in Minnesota, Endangered in Illinois, Indiana, Michigan, Ohio, and Wisconsin.

[3]Threatened.

5.084 Each state is presently formulating its own lists for endangered and threatened species. Sources for these lists can be found in Appendix F.

5.085 Recent studies have identified the presence of bald eagles in the project area along both the St. Marys River (Sugar Island area) and the St. Lawrence River(7, 8). Results of these studies show that disturbance by ships and by monitoring efforts, alteration of open pools, and indirect effects on food sources may all have short-term significant impacts on the wintering bald eagles. Summaries of the studies are located in Appendix F.

5.086 In 1978, under the Environmental Assessment for the FY 1979 Winter Navigation Demonstration on the St. Lawrence, a study was completed for the Fish and Wildlife Service (FWS) entitled Bird Studies During the Winter of 1978 (9). This study stated evidence

that bald eagles were disturbed by ship passages and cited one specific incidence. In accordance with Section 7 of the Endangered Species Act of 1973, as amended, a formal consultation was completed with Region 5, FWS. They concluded that the Demonstration Program would not jeopardize the continued existence of the bald eagle. However, a recent study entitled Waterfowl, Waterbird, and Raptor Study - St. Lawrence River (7) introduces new evidence to support that the wintering eagles may be disturbed by vessel passages. If required, formal consultation would again be initiated.

5.087 The gray wolf (timber wolf) has been maintaining very small populations in the western and central regions of Michigan's Upper Peninsula. However, there have been no recent sightings of the gray wolf in the St. Marys River area on the United States side, but there have been sightings, by conservation officers and trappers, on the Canadian side of the St. Marys River. According to wolf experts, the St. Marys River area does have favorable habitat for the gray wolf, but due to a past coyote bounty in the State of Michigan and pressure from human development, there are currently no resident, breeding populations in this area. However, the coyote bounty arrangement has been terminated which might improve the possibility of the wolf establishing a breeding population in Michigan's Upper Peninsula. There is a study underway by Dr. William L. Robinson and Dr. Roy E. Heath to determine the effect of winter navigation on migration and dispersal of land mammals (including the gray wolf) in the project area.

5.088 No studies have been started, to date, to determine the effects of the proposed plan on any of the other endangered and/or threatened species. However, in accordance with Section 7 of the Endangered Species Act of 1973, as amended, studies, field reconnaissance, and consultation with the Fish and Wildlife Service (FWS) would be completed before implementation of the project.

5.089 The EPOA recommends that a system-wide study be conducted on endangered and threatened species and their critical habitat. Existing data would be compiled and additional field work performed. Further investigation would take place where proposed activities may require an environmental document.

5.090 Oil Spills. Since there cannot be an absolute guarantee that it could not happen, the potential for an oil spill occurring during an extended season program does exist. For a number of reasons, that potential is lower in stable ice conditions and higher during spring breakup, when the ice is moving downstream in rivers and bays near rivers. Under the various circumstances which could occur during a spill, the containment and clean-up operations could be either less difficult or more difficult than similar operations taking place during warmer weather.

5.091 Although the Great Lakes have never experienced a catastrophic winter related oil spill exceeding 100,000 gallons, a spill could occur and be locally devastating to fisheries and wildlife.

5.092 The U.S. Coast Guard has developed a number of excellent contingency plans for spill clean-up and containment. Response time has been reduced to a few hours and good equipment is available. However, based on comments received on the Draft Report, Environmental Impact Statement, and the numerous public workshops and meetings, it appears that the public and agencies with the primary mission of protecting natural resources strongly desire further improvement of the ability to handle oil or toxic material spills. Contingency plans, technology, and equipment should continue to be improved to afford better protection for water quality and fish and wildlife resources which are essential to the health and economic well-being of much of the population of the Great Lakes Basin. These resources also form the basis of a multi-billion dollar tourist and recreation industry. Therefore, continued improvement of technology, technology transfer, contingency plans, and equipment is warranted and is proposed under the Environmental Plan of Action to afford the level of protection desired by the public. A discussion of oil contingency plans is located in Appendix F, Oil Spills.

Social Environmental Resources

5.093 Noise. The level of sound (noise) is an increasingly important indicator of the quality of the environment. Ramifications of various sound levels and types could be reflected in health (mental and physical) and/or aesthetic appreciation of an area. A sound is determined to either be acceptable or unacceptable depending on the loudness, duration, and timing. Various guidelines and regulations have been established at Federal and State levels showing this comparison. The Occupational Safety and Health Administration (OSHA) has provided general acceptability guidelines for various noise levels. Refer to Appendix F for specifics on the OSHA guidelines.

5.094 Icebreaking and commercial vessel operations would also create a significant increase in noise during times where, historically, navigation ceased in winter. Even though operations would occur in the early winter months, the introduction of physical impacts year-round could be of concern. The magnitude of this impact on the adjacent areas would depend on the nature of the areas themselves.

5.095 Overall, noise problems are complex since they depend on distance, wind, weather, and the particular listener. While it is possible to identify and quantify sounds attributable to various

operations, it is difficult to predict the subjective interpretation in a given location under varying conditions. Impacts are expected to be of a low nature due to the reasons stated above. However, many permanent residents of connecting channel areas may be irritated by the change.

5.096 Aesthetic Values. Impacts on aesthetic values could result from the passage of vessels, during the winter months, in areas where there was no winter movement prior to season extension. Based on information from public meetings with residents, these passages could have either a positive or negative impact. That is, the vessel passages were considered detrimental by most of the riparians who spoke, but enhancing by others. Appendix H discusses this and other perceptually based concerns.

5.097 Recreation. Ice fishing and snowmobiling are the two most prevalent forms of winter recreation on the Great Lakes System. Other activities include iceboating, sail skating, ice skating, travel by other vehicles, and cross-country skiing.

5.098 Effects of winter navigation on recreation stem from the weakening of the ice cover through vessel transists (including icebreaking), bubbler systems, ice booms, and other mitigative measures. This weakening could cause some portions of the remaining ice cover to be unsafe for "on ice" activities such as ice fishing.

5.099 This weakening of the ice cover was encountered in five harbor areas during the Winter Demonstration Program. These areas were Duluth/Superior in Minnesota; Escanaba, Saginaw Bay and Lake St. Clair in Michigan; and Sandusky in Ohio.

5.100 The Bureau of Outdoor Recreation (now the Heritage Conservation and Recreation Service) studied thirty-eight harbors and the four connecting channels of the Great Lakes in the latter half of the winter 1975-76 in order to determine the adverse and beneficial impacts of navigation on winter recreational activities occurring on the ice. Results of these studies and numerous other studies on the effects of winter navigation on recreation are incorporated into Appendix H -Social.

5.101 The impact of the recommended plan on existing recreational resources, both man-made and natural, have not been fully assessed. Some recreational opportunities such as ice fishing, on or near navigation channels would be curtailed due to the proposed project. Compensation in the form of project related recreational facility enhancement or expansion would be considered as actual adverse effects were quantified. Such impacts would have to be quantified in terms of actual loss of man-days fishing in a given area, and not in terms of fishermen relocating to other nearby areas of relatively

equal value. In the current Demonstration Program navigational and recreational interests have adapted to one another.

5.102 Icebreaking in nearshore or constricted areas, without proper notification, could create unsafe ice conditions for sport and commercial fishermen. Access to traditional fishing sites could, in some cases, be hampered by maintaining vessel tracks throughout winter. Use of the ice as a bridge by both man and animal could be curtailed in those areas kept open for shipping.

5.103 Cross Channel Transportation. The effects of extended season navigation on cross channel transportation stem from ice clogging ferry docks and disrupting service and the disruption of cross channel pedestrian and vehicle traffic through the maintenance of vessel tracks in the ice cover.

5.104 Residents potentially subject to transportation service interruption through ice clogging of ferry docks are those living on Sugar, Neebish, and Drummond Islands (St. Marys River), as well as five ferry crossings along the St. Clair-Detroit Rivers. Another source of transportation interruption, due to winter navigation, would be the disruption of cross channel pedestrian and vehicle traffic caused by the maintenance of vessel tracks in the ice cover. In addition to the areas mentioned above, Neebish Island's west channel, if used, and Drummond Island's alternative route, Lime Island (St. Marys River) and the area around Grindstone Island (St. Lawrence) would be subject to interruption.

5.105 Engineering solutions are proposed which would prevent or mitigate disruption to cross channel transportation caused by extended season navigation. Such mitigative measures proposed include ice booms, rubble islands, air boat (Lime Island), and bubbler/flusher systems. A detailed discussion of this impact and the mitigating measures is found in Appendixes B - Plan Formulation and H - Social. It can be expected that many of the affected people will object to the resulting change in their life-style.

5.106 Occupational Groups. Four occupational groups (vessel, terminal, lock, and pilot personnel) have been identified as being directly affected by season extension operation. The effects on these groups are basically of two types, individual safety and comfort, and the "psycho-social" effects of extended season operation (morale, family relations, change in vacation time, etc.). These effects occur on all vessels operating in any part of the system during the extended season, at all terminals receiving extended season traffic, and at the locks operating during the extended season. Both engineering and procedural solutions are being developed, based on previous studies assessing the nature and magnitude of the impacts. Continuing objections by some to alteration in life-style can be expected.

5.107 As a result of an extended navigation season a number of port jobs would be created over a period of time. Port jobs to be added include longshoremen, stevedores, terminal operators, merchant seamen, ship and equipment repair personnel, freight forwarders and agents, steamship company personnel, and pilot and port administrators. Projected figures of additional jobs in the Great Lakes Region range from 3,072 in 1990 to 8,645 by the year 2040 (refer to Appendix D). A more detailed discussion of these occupational groups and the impacts that winter navigation would have on them is located in Appendix H - Social.

5.108 Land Use. Local increases in the labor force could cause some changes in land use patterns in the area. An increase of population in an area could create an increased housing demand. This demand could stimulate residential and related commercial development. Other secondary effects of a population increase include changes in demand for utilities, recreational facilities, and community services.

5.109 Other activities under the recommended program which could affect land use include clearing or alteration of sites for aids to navigation and the use of upland areas designated for dredged material disposal. Ferry service, ice fishing, and other forms of recreation could be disrupted or halted, influencing land use patterns.

5.110 The above factors and others will continue to be evaluated in post authorization environmental statements as needed, to determine the impact of navigation season extension on land use.

5.111 Shoreline Structure Damage. Another type of winter navigation related effect is shore erosion and shore structure damage (primarily docks).

5.112 Natural winter ice conditions have always subjected private shoreline structures to ice forces, sometimes causing damage. However, it is expected that there would be a change in the type and magnitude of winter ice forces imposed on private shoreline structures with winter navigation. Icebreaking and vessel movement could result in increased structural damage to privately owned dock and recreational facilities not designed to withstand winter navigation, especially in the connecting channel reaches. The extent of such damage would be difficult to quantify for any particular winter season in that it seems to be directly related to a number of factors, including, among others, the severity of ice conditions, the duration of extended season activities, the amount and type of icebreaker support used, and the number of commercial vessels actively participating in the program.

5.113 A shoreline protection study is underway to identify structure damage prone areas within the Great Lakes, their connecting channels, and the St. Lawrence River, that are considered influenced by winter navigation. The study attempts to evaluate the change in the incidence and degree of damage that could be incurred by private structures under extended navigation. A probabilistic approach is being developed which consists of characterizing the ice conditions, on a reach-by-reach basis, that occur under natural conditions and under several plans of winter navigation. On the basis of these ice conditions and on the basis of the channel characteristics within each reach, two probability estimates are made. First, estimates of the probability of occurrence of ice damage in each reach are made. Second, estimates are made which express the likely severity of ice damage to each reach in probabilistic terms. There remains the need to translate the probability estimates into terms more tangible, such as dollar cost. This cost is being based on replacement by like construction.

5.114 In order to keep compensating costs down and reduce the need to mitigate potentially adverse impacts, high-risk areas could be Federally protected, vessel speeds controlled, vessel routes regulated, and regulation of vessel movement through unstable ice fields could be instituted. See appropriate portion of the Main Report - System Consideration Section.

5.115 Engineering solutions are currently being developed to prevent or mitigate shoreline erosion and shore structure damage, based upon previous studies assessing the problem.

5.116 Community Cohesion. There is no construction planned within the season extension program which would displace residents. There could be some voluntary relocation based on personnel preference, but this would be minor and would have no impact on community cohesion. Some observers have reported increases in community cohesion resulting from the organization of interest groups to express and promote a specific viewpoint, usually opposition, regarding winter navigation.

5.117 Displacement of Farms. There should be no displacement of farms as a result of season extension.

5.118 Desirable Community Growth. In general, desirable community growth is expected to increase slightly in response to improvement of the region's economy due to season extension, as outlined in Appendix D on regional economic benefits. Individual communities may experience different levels of growth due to winter navigation; however, phased implementation should be gradual enough so that this growth will not be disruptive or that it cannot be incorporated into existing community planning mechanisms. This is discussed more fully in Appendix H.

5.119 Public Facilities. No significant effects on public facilities due to season extension are expected. Any increase in population growth, which could put pressure on public facilities, would result from the improvements to the region's economy due to season extension and would be gradual over the life of the program. Appendix H recommends that this be monitored as part of the "social well being" of the region. (Note that island transportation is treated specifically elsewhere in the document and is not included here under "Public Facilities.")

5.120 Energy. Navigation through ice requires a commitment of natural resources such as coal and oil for the additional energy required. Increased energy is required for a lengthened time of transit due to ice conditions and the increase in equipment.

5.121 In order to determine the energy impact of extending the navigation season on the Great Lakes/St. Lawrence Seaway (GL/SLS), an Energy Impact Study was conducted (refer to Appendix D). Specifically, this study compared the energy consumption associated with winter waterborne movement of bulk and general cargo during an extended navigation season to the energy consumption associated with winter movement of the same commodities via the least-cost alternative transport mode (rail, truck, barge). Included in the analyses were the increased transit times and delays that would be associated with winter navigation operation for the various size vessels and icebreakers in the Great Lakes and overseas fleets, as well as energy expended by the facilities and operations required to support winter navigation. The results of the Energy Impact Study indicate that there would be a small, but positive, energy savings associated with the increased GL/SLS waterborne movement that would result from an extended navigation season. Therefore, while the energy would be irreversibly committed to this program, a greater amount would be saved through reductions in consumption by trucks or railroads. It should also be noted, however, that this net energy gain although small, has been calculated on a conservative basis and actual experience would most likely show a greater savings than calculated.

5.122 Public Services. Power generation could be affected by this program. Specifically, a temporary reduction in levels and/or flows may shift or reduce power generating capability or peaks in the nearby downstream portion of the system. Conversely, increases (short of flooding) would increase power generating capability. This is discussed in detail in Appendix I. The liability aspects of this question are discussed in detail in Appendix J, with particular reference to the situation on the St. Lawrence River regarding regulatory authority and liability. No significant impact on other public services is expected due to season extension. Any increase in population growth which could put pressure on public services would result from improvements to the region's economy due to season extension and would be gradual over the life of the program.

Appendix H recommends that this be monitored as part of the "social well being" of the region.

5.123 Regional Growth. A Regional Economic Impact Study (shown in Appendix D) was accomplished to determine the secondary economic impacts on the Great Lakes Region of an extended navigation season. In addition to the primary transportation related benefits associated with an extended navigation season (transportation rate, winter rate, and stockpiling savings), navigation season extension would also have a beneficial regional impact on the Great Lakes region in terms of increased income and employment. This study depicts the regional benefits and employment accruing directly to Great Lakes ports, as well as the regional economies surrounding these ports. It is essential to note that these regional benefits basically only represent regional transfers of income to the Great Lakes from other regions of the country. As such, these benefits are not included in the project's overall benefit/cost ratio, which only addresses net increases in the nation's overall efficiency in the transportation of goods (as reflected in the project's primary transportation related benefits). A recent study prepared at the request of the Governor of New York has concluded that an 11 month navigation season on the St. Lawrence River would be detrimental to the State of New York and the Nation. The study was prepared by a contractor hired by the State of New York (10).

5.124 The annual stockpile of iron ore and coal would be affected by the shipping season extension. During the winter, when the Great Lakes are non-navigable, plants utilizing coal and iron ore are forced to stockpile. The season extension would allow for a continuous supply of raw materials. It is projected that by the year 2040, 33,977,000 tons per year of material would be saved from stockpiles (refer to Appendix B). Stockpiling saving would result in reduced storage facilities and inventories, with more land becoming available for industrial expansion.

5.125 Business and Industry. In addition to the general regional benefits resulting from any increase in the Great Lakes Region's improved competitive posture due to season extension (discussed above), additional specific benefits would accrue to business and industry in the region. Companies in the Great Lakes Region that may realize savings from the lower transportation costs associated with winter navigation may either pass these savings on to the consumers of the product in the form of lower prices, or they may reinvest these savings back into the company, resulting in increased production, income, and employment in the Great Lakes area.

Historic and Cultural Resources.

5.126 A preliminary study of the United States' cultural resources potentially impacted by the extended navigation season on the Great

Lakes is included in Appendix F. This study was prepared by the Earth Systems Division of Soil Systems, Inc. (SSI) for the U.S. Army Corps of Engineers - Detroit District. Cultural resources consist of known prehistoric archaeological sites, extant historical structures, and submerged ship wrecks. The areas considered for cultural resources were limited to within 500 feet from the shoreline in harbors, channels, and connecting waterways.

5.127 Visits by the various researchers were made to the offices of the State Historic Preservation Officer (SHPO) of each state with shoreline involved. These included Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York. Records of prehistoric and historic archaeological sites, historic structures, shipwrecks, and paleontological sites were examined. Resources outside the SHPO offices were identified and information obtained from such additional sources as universities, historical societies, paleontologists and interested citizens. Finally, the 1979 National Register of Historic Places, the Historic American Engineering Record, and the Historic American Buildings Survey were consulted. The specific areas covered in the assessment of records and literature were the 43 commercial harbors proposed for winter navigation, harbors with present or proposed icebreaker facilities, connecting channels, connecting rivers, islands and the St. Lawrence Seaway.

5.128 The results of the records and literature work clearly indicate that there are insufficient data available on the specifics of the proposed activities to arrive at any comprehensive assessment of the potential impacts on cultural resources by this recommended project. Literally hundreds of archaeological sites, historic structures and shipwrecks dot the shoreline, channels and harbors. Unfortunately, the locational data and descriptive information produced throughout the period of colonial history did not anticipate the needs of cultural resource management. The hit or miss nature of assembling these records over the years leaves vast areas of unsurveyed shoreline and virtually no systematic shipwreck location data.

5.129 Underwater surveys of the same areas should be undertaken with the added dimension of surveying shipping lanes in which the water depth is less than fifty feet. Only in this fashion, with data collected specifically with cultural resource management problems in mind, can the significance, impacts and appropriate mitigation procedures be established.

Effects of the Alternative to the Proposed Action

5.130 The alternatives to the proposed action considered by the Corps of Engineers is the No Further Action Plan (31 Jan ± 2 weeks).

No Further Action Plan

5.131 The No Further Action Plan (31 Jan ± 2 weeks) (Base Condition) alternative would involve no change in Federal action and, therefore, is the NO ACTION ALTERNATIVE. The following impacts are those discussed in Section V of the EIS for the Interim Feasibility Report, March 1976. These provide information for the EPOA and become elements for total management of the environmental impacts of extending winter navigation.

5.132 The activities of the Interim Extended Navigation Program are expected to produce no major adverse environmental impacts. Two of the activities of the proposed program, the Sugar Island bubbler-flusher system, and the ice booms in the Little Rapids Cut are directed at mitigation of adverse impacts of the extension of the navigation season.

5.133 Structural damage to privately owned dock and recreational facilities is likely to occur in relation to continuation of the extended season activities and to mitigation measures identified and implemented. Shoreline areas particularly prone to such damages would be difficult to quantify for any particular winter season in that they are directly related to a number of factors, including but not limited to the severity of ice conditions, the duration of extended season activities, the amount of icebreaker support and the number of commercial vessels actively participating in the program. During the later years of the Demonstration Program, a number of randomly selected dock structures were studied on the St. Marys River in an effort to ascertain the nature, extent and causes of damages incurred to them during the extended season. In general, periodic observations revealed that the majority of docks damaged were older structures that had not been routinely maintained by their owners to insure the original structural integrity. A study, presently underway, will identify shoreline impacts, mitigation measures and monitoring for a long range program.

5.134 Ice jams and potential flooding on the St. Marys River. Ice booms in Little Rapids Cut and Sugar Island bubbler-flusher system are directed at mitigation of adverse effects of the navigation season. These adverse effects include potential ice jams in St. Marys River which could cause Soo Harbor area flooding and disrupt power production, obstructionn to ferry crossing in the Cut and to commercial ship movement. Further mitigation is provided by the Little Rapids Cut Operational Plan which prescribes criteria for terminating winter season shipping through Little Rapids Cut area of the St. Marys River before it causes unacceptable problems to Sugar Island residents.

5.135 <u>Oil and hazardous substances spills</u>. The impacts would be similar to those discussed for the Selected Plan, Section 5.090-5.092 of this statement.

5.136 Effects of open channel changes to the environment which have a potentially adverse effect due to maintenance of an open channel in a normally ice covered area include: interruption of wildlife migration (waterfowl and terrestrial animals); disruption of recreation such as ice fishing, snowmobiling and iceboating; impairment of aquatic habitats and life cycles due to maintenance of channels and transit of vessels through channels.

5.137 Flooding from ice jams caused by navigation extension activities; two adverse effects are of immediate concern. One is related to variations in water levels which could result in the destruction of aquatic habitats identified in sensitive shoreline areas of the connecting channels. The other is the removal of habitats and biological communities as a result of shoreline erosion. A related concern is for the adverse effects which might occur if ice build-up continues in the channel throughout the winter, and results in larger than average pieces passing through the system during spring break-up.

5.138 <u>Environmental Appraisal Program</u>. The environmental evaluation of the extended navigation season is primarily concerned with three types of impacts. They are the environmental impacts of ice control measures, of vessel transits, and of support systems. Implicit in these types of impacts are the impacts of maintaining an open channel on all kinds of established uses of the affected water, air and land. These uses include those of the flora and fauna for maintaining the restricted food chain, as well as those of man, for recreation and co-existence.

5.139 Evaluation of such impacts requires field data collection and research continued over time and based on a certain amount of baseline information and on operational sampling. Preliminary assessments of anticipated impacts of all operational elements must be made in order to ensure that the demonstration activities themselves will not have serious environmental consequences, but quantitative evaluation of impacts cannot be accomplished without actual implementation of the process or installation of the device.

5.140 The environmental appraisal program has identified environmental concerns to be investigated in relation to the operational activities. With implementation of the program these would be further developed into field studies for producing the kinds of information useful in assessing impacts of the activities. The data would be useful for identifying alternatives and mitigating actions as required. Complete description of the program is contained in the Interim Feasibility Report.

5.141 Although they are not impacts in themselves, development of data necessary for the operation of navigation aids and other supporting systems is considered important from an environmental standpoint since subsequent evaluation of this data could supply baseline information for evaluation of the environmental impact of the entire extended navigation program.

5.142 Each of the eight Great Lakes states involved in the development of coastal zone management programs will be made aware of and kept up to date on the extent of activities associated with the winter navigation program. The Winter Navigation Board has appointed a representative of the Great Lakes States to the Board. Coordination has been established with the Standing Committee for Coastal Zone Management of the Great Lakes Basin Commission which is composed of representatives of each of the Great Lakes States and the Federal agencies associated with coastal zone management.

VI PUBLIC INVOLVEMENT

6.01 Expressed views, desires and concerns of the public were obtained at various public meetings which were announced by mail, in press releases, and in the Federal Register. These notices were issued two months prior to the date of the meeting, as required by Federal law. Initially, a set of three public meetings were held; the first on 24 May 1972 in Chicago, Illinois, the second on 10 July 1972 in Cleveland, Ohio, and the third on 11 September 1972 in Duluth, Minnesota, Sault Ste. Marie, Michigan and Detroit, Michigan. Two additional series of public meetings were held during January 1974 (Duluth, Minnesota; Sault Ste. Marie, Michigan; Detroit, Michigan) and February 1976 (Duluth, Minnesota; Sault Ste. Marie, Michigan; Cleveland, Ohio) to present to the public the findings and recommendations of an interim report to extend the navigation season in the upper four Great Lakes, and to then solicit their views.

6.02 A public seminar was held in December 1972 in Detroit, Michigan, for discussion of the Winter Navigation Program.

6.03 In 1975, a public workshop was held in Sault Ste. Marie, Michigan, to discuss the effects of vessel transit during the winter on the St. Marys River shoreline and to present the results of a study conducted in 1974 on the effects of winter navigation on the shoreline.

6.04 A public meeting was held in January 1977 at Sault Ste. Marie, Michigan, to obtain public needs and views relative to the navigation season extension survey study and Demonstration Program. On 6 October 1977, the concepts of future direction of both the survey and Demonstration Program were presented to the public in Cleveland, Ohio.

6.05 Also in 1977, nine public workshops, sponsored by the U.S. Fish and Wildlife Service, as an agent for the U.S. Army Corps of Engineers, were conducted at five locations in the Great Lakes Basin. The purpose of the workshops was to obtain citizen input relative to potential impacts of winter navigation.

6.06 Eight public workshop meetings were held in August and September 1978 at various locations along the Great Lakes and the St. Lawrence River. Seven public meetings were held in 1979 in April and May in: Gary, Indiana; Detroit, Michigan; Duluth, Minnesota; Sault Ste. Marie, Michigan; Cleveland, Ohio; Massena, New York; and Watertown, New York.

6.07 The inputs from the public were many and varied, but the most often stated concerns were related to: shore erosion; icebreaking; oil spills; levels and flows; lack of adequate environmental baseline data; and questions on who, specifically, would be the beneficiaries of extended navigation and who would pay the cost.

6.08 A number of publications and television programs have done features on the navigation season extension. Articles have appeared in such

publications as: Journal of Commerce, Detroit News, New York Times, Los Angeles Times, Chicago Tribune, Wall Street Journal, and Washington Post. Features on winter navigation have been done by the Canadian Broadcasting Corporation and by the American Broadcasting Company's investigative news program, 20/20.

6.09 In the planning of new project proposals, a required route of coordination must be followed. This route has been followed in the planning of navigation season extension on the Great Lakes System. The Corps of Engineers prepared a preliminary summary of environmental considerations. This report was submitted to the District and Division Engineers, who decided further study was warranted. Having been approved, the Corps of Engineers is required by law and regulations to coordinate its water resource planning studies with other Federal, State and local agencies, as well as with individual and private groups. The specific Federal and State agencies with which this official coordination has been accomplished follows:

FEDERAL

Agency	Location
Advisory Council on Historic Preservation	Washington, DC
Energy Research & Development Administration	Washington, DC
U.S. Dept. of State, Office of Canadian Affairs	
Environmental Protection Agency	Chicago, IL
Federal Energy Regulatory Commission	Chicago, IL
International Joint Commission, U.S. Section	Washington, DC
National Aeronautics & Space Administration	Cleveland, OH
U.S. Department of Agriculture	Washington, DC
U.S. Forest Service	Upper Darby, PA
U.S. Department of Commerce	
Maritime Administration	Cleveland, OH
National Oceanic & Atmospheric Admin.	Rockville, MD
Great Lakes Environmental Research Lab.	Ann Arbor, MI
National Weather Service	Silver Springs, MD
U.S. Department of Defense	
Office of Chief of Engineers	Washington, DC
Board of Engineers for Rivers & Harbors	Fort Belvoir, VA
U.S. Army Engineer Division, North Central	Chicago, IL
U.S. Army Engineer Districts	St. Paul, MN
	Buffalo, NY
	Chicago, IL
Cold Regions Research & Engineering Lab.	Hanover, NH
U.S. Department of Health, Education & Welfare (Public Health Service)	Chicago, IL
U.S. Department of Housing and Urban Development	
U.S. Department of Interior	
Bureau of Mines	Pittsburgh, PA
National Park Service	Omaha, NE

U.S. Fish & Wildlife Service	Twin Cities, MN Newton Corners, MA
Heritage Conservation & Recreation Service	Ann Arbor, MI Philadelphia, PA
U.S. Department of Transportation	
St. Lawrence Seaway Development Corp.	Washington, DC
U.S. Coast Guard	Cleveland, OH
Federal Highway Administration	Washington, DC

CANADIAN

St. Lawrence Seaway Authority of Canada
Coast Guard, Canada
Environment Canada
Ministry of Transport, Canada
Ministry of External Affairs

STATE

Illinois
- Office of the Governor
- Clearing House
- Coastal Zone Management Office
- Department of Commerce
- Department of Natural Resources
- Department of Transportation/Division of Water Resources
- Environmental Protection Agency
- State Historic Preservation Office

Indiana
- Office of the Governor
- Clearing House
- Coastal Zone Management Office
- Department of Commerce
- Department of Natural Resources
- Stream Pollution Control Board
- State Highway Commission
- State Historic Preservation Office
- State Planning Agency

Minnesota
- Office of the Governor
- Clearing House
- Coastal Zone Management Office
- Department of Commerce
- Department of Natural Resources
- Department of State Highways and Transportation

Minnesota (Cont.)
- Pollution Control Agency
- State Planning Agency
- State Historic Preservation Office

STATE

Michigan
- Office of the Governor
- Clearing House
- Coastal Zone Management
- Department of Agriculture
- Department of Commerce
- Department of Natural Resources
- Department of State Highways and Transportation
- State Historic Preservation Office
- State Planning Agency

Ohio
- Office of the Governor
- Clearing House
- Coastal Zone Management
- Department of Natural Resources
- Department of State Highways and Transportation
- Environmental Protection Agency
- State Historic Preservation Office
- State Planning Agency

Pennsylvania
- Office of the Governor
- Clearing House
- Coastal Zone Management Office
- Department of Commerce
- Department of Environmental Resources
- State Historical Preservation Office
- State Planning Agency

New York
- Office of the Governor
- Clearing House
- Coastal Zone Management Office
- Department of Commerce
- Department of Environmental Conservation
- Division of State Planning
- State Historic Preservation Office

Wisconsin
- Office of the Governor
- Clearing House
- Coastal Zone Management Office
- Department of Commerce
- Department of Local Affairs and Development
- Department of Natural Resources
- Department of State Highways and Transportation
- State Historic Preservation Office
- State Planning Agency

REGIONAL

Great Lakes Commission
Great Lakes Basin Commission

6.10 A series of public workshops was held during the plan formulation stage. Ideas and alternatives gathered from these meetings were incorporated in the Draft Environmental Impact Statement (EIS) and Report written by the District Engineer. Copies of the Draft are circulated to concerned Federal, State and local agencies and public interest groups for review and comment. Copies are also sent to higher authority and the Council on Environmental Quality (CEQ). The District Engineer - Public Affairs Office issues a news release announcing the availability of the draft report and EIS.

6.11 Following more public meetings and public review of the draft report and EIS, the District Engineer completes the survey report and prepares a final EIS. All comments received, together with an appropriate response, are included in the Public Views and Responses, Appendix C. The final survey report and EIS will be submitted to the Division Engineer for review. After his review and approval, the report is transmitted to the Board of Engineers for Rivers and Harbors (BERH) and the Office Chief of Engineers (OCE) for review. A public notice is issued noting the availability of the main report and EIS. Although the EIS in the main report is identified as a "final" at this stage of processing, it should be clear to all those receiving a copy that it is an "Interim Document Under Agency Review -Subject to Revision" and will become final when it is filed with EPA after BERH and OCE reviews.

Following OCE and BERH review, the OCE will review the recommendations of the BERH and prepare the proposal Report of the Chief of Engineers.

6.12 The main report and final EIS, together with the proposed report of the Chief of Engineers and the BERH report, will be filed with EPA at the same time as the report is circulated for 90-day Departmental review to the concerned state(s) and Federal agencies at the Washington level. Letters of comment on the final report and EIS will be answered on an individual basis and included within the Public Views and Responses, Appendix C, under a section titled "Comments and Responses Received During Departmental Review."

6.13 Copies of the main report, final EIS, and all appendixes will be forwarded to OCE for preparation of the final Chief of Engineer's report. After completion of reviews, the Chief of Engineers will sign his final report which will include a record of decision and will transmit the report and accompanying document to the Assistant Secretary of the Army for Civil Works ASACW. After his review, the (ASACW) forwards the report to the Water Resources Council (WRC) for technical review. After WRC review the report is returned to ASACW who transmits it to the Office of Management and Budget (OMB) requesting its views, and approval, in relation to the program of the President. After OMB provides its views, ASACW will transmit the report to the Congress and release it to the public.

List of Agencies, Organizations and Persons to Whom Copies of this Statement were sent:

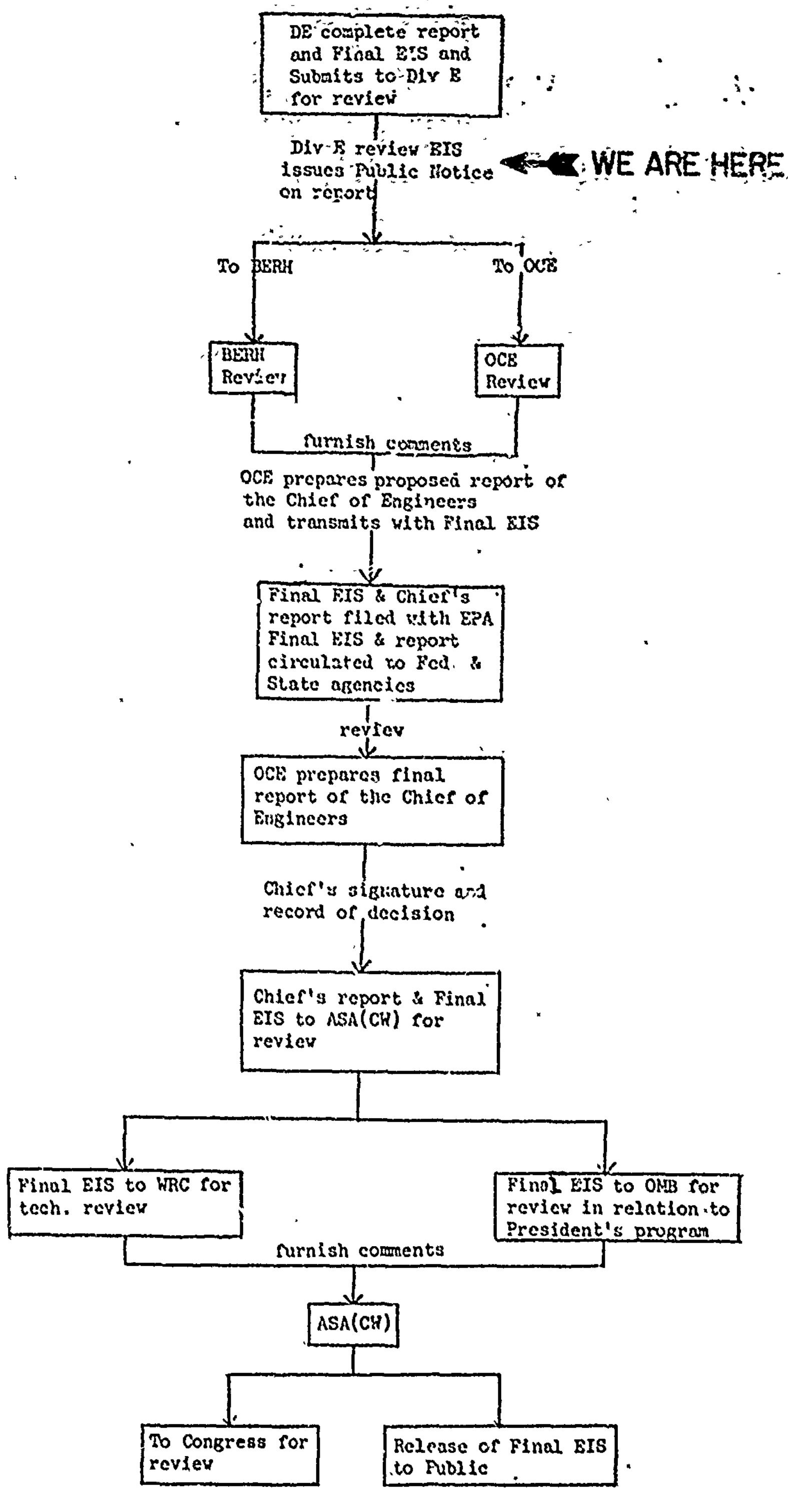
6.14 Due to the number of agencies and individuals to whom this report has been sent (approximately 1500), only a partial list of agencies is included herein. A complete list may be obtained through the U.S. Army Engineer District, Detroit, P.O. Box 1027, Detroit, Michigan, 48231.

Canadian Coast Guard
Cleveland-Cuyahoga County Port Authority
Department of Conservation - Illinois
Department of Environmental Resources
Department of Natural Resources
Department of Transportation - Minnesota
- Ohio
- Pennsylvania
Detroit-Wayne County Port Commission
Embassy of Canada
Environmental Protection Agency
Federal Energy Regulatory Commission
Governor of New York
Great Lakes Basin Commission
Maritime Administration
Michigan Department of Labor
Michigan Water Resources Coordination
National Oceanic Atmosphere Administration
National Wildlife Federation
St. Lawrence County Environmental Management Council
St. Lawrence Seaway
St. Lawrence Seaway Development Corporation
State of New York - Department of Environmental Conservation
Toledo-Lucas County Plan Commission
Toledo-Lucas County Port Authority
U.S. Army Engineer Districts
U.S. Coast Guard
U.S. Department of Commerce
U.S. Department of Interior - Bureau of Mines
- Fish and Wildlife Service

6.15 The Fish and Wildlife Coordination Act states in part that the equal consideration of fish and wildlife conservation be coordinated with the other features of the water resources development programs. Continual coordination with the Fish and Wildlife Service (FWS) is also mandated in this law. Coordination with the Fish and Wildlife Service on the Extended Navigation Season Program was initiated when the FWS was made part of the Winter Navigation Board. One result of this coordination was the Fish and Wildlife Report, June 1979, which establishes a series of general and specific recommendations concerning this program. A complete copy of this document appears in Appendix G. The Corps of Engineers responses to the FWS recommendations appear in Appendix C.

6.16 Summaries of comments received, categorized by concerns expressed, are included in this section of the report. These comments were submitted by other agencies and the public, and do not necessarily encompass all currently known information. Complete comments in context of the correspondence, with responses, are included in Appendix C - Public Views and Responses.

REVIEW PROCESS LEADING TO AUTHORIZATION



LEGEND

ASA(CW) -Assistant Secretary of the Army for Civil Works
DE -District Engineer
Div E -Division Engineer
OCE -Office Chief Engineers
BERH -Board of Engineers for Rivers and Harbors
PAD -Public Affairs Office
CEQ -Council on Enviromental Quality
EIS -Enviromental Impact Statement
OMB -Office of Management and Budget
WRC -Water Resources Council

FIGURE 5

Agencies and Individuals from Whom Comments have been Received

In addition to those received and documented in public meetings, the following is a list of agencies and individuals from whom comments have been received concerning the environmental impacts of the proposed projects:

FEDERAL AGENCIES

1. U.S. Department of Agriculture - Forest Service (USFS).
2. U.S. Department of Commerce - National Oceanic and Atmospheric Administration (NOAA).
3. U.S. Department of Health, Education and Welfare - Public Health Service (HEW).
4. U.S. Department of the Interior - Fish and Wildlife Service (FWS).
5. U.S. Environmental Protection Agency (EPA).

STATE AND LOCAL AGENCIES

6. Drafter Township
7. Governor Milliken
8. Illinois - Bureau of the Budget
9. Illinois Department of Transportation (IDOT)
10. Keweenaw County Board of Commissioners
11. Michigan Department of Natural Resources (MDNR)
12. Monroe County Planning Department and Commission
13. New York State Department of Environmental Conservation (NYSDEC)
14. Ohio Department of Natural Resources (ODNR)
15. Pennsylvania State Clearinghouse
16. St. Lawrence County Environmental Management Council
17. St. Lawrence - Eastern Ontario Commission
18. State Clearinghouse - Columbus, Ohio
19. Town of Waddington, New York
20. Wisconsin, Office of the Governor

PRIVATE GROUPS AND ORGANIZATIONS

21. Citizens for Clean Land, Air and Water (CLAW)
22. East Michigan Environmental Action Council
23. Lake Michigan Federation
24. Michigan United Conservation Clubs (MUCC)
25. Save the River

PRIVATE CITIZENS

26. Andres, Kristin (Lancaster, NY)
27. Blackburn, Bruce W. (Minneapolis, MN)
28. Davis, Gordon (Westminster, SC)
29. Holt, F. Sheppard (Winchester, MA)
30. Martell, Albert (Superior, WI)

31. Rebmann, Edward D. Jr. (Blasdell, NY)
32. Rush, Joan E. (Washington, DC)
33. Smith, Marion (Syracuse, NY)
34. Veitch, R. Elwood (Waddington, NY)
35. Vitek, Joseph (Saginaw, MI)

Public Concerns and Comments

Adaptive Study Method

1. This method ignores long-term damage which could continue unseen. (20, 22)

2. It violates various environmental acts. (22)

3. The use of the Adaptive Method requires a decision to proceed with winter navigation before the true cost of the project is known. (5, 9, 20)

4. This method inadequately deals with the impacts from operational measures needed for 11 month navigation. (16)

5. It violates NEPA since it advocates collection and assessment of data after project authorization and implementation. (4, 11)

6. There is concern with the ability to terminate project activities should impacts arise which cannot be mitigated. (17, 20)

7. Impacts discovered after the fact may be irreversible and irretrievable. (11)

8. There should be two-phased authorization rather than one-phased. (4, 5, 7, 20)

* The number(s) following each statement correspond to the numbers given to the agencies, groups, or individuals who raised these concerns (listed on the previous page).

Spills of Toxic Substances

1. There is no effective way of containing oil and chemical spills under ice. (35)

2. A certain percentage of oil content dissolves in the water and causes kills regardless of clean-up. (22)

3. Chemical spills cannot be cleaned up. (22, 34)

4. There is a lack of an adequate contingency plan. (3, 4, 5, 16, 20, 22)

5. The scenario presented assumes that the oil spilled is contained in the ice. However, if the ice were non-fast ice, the oil would travel farther, be harder to recover, and do more environmental damage. (22)

6. There needs to be an identification of critical hazard areas. (14)

7. There should be development and testing of new recovery techniques. (7)

8. Oil spills are a probable recurring type of adverse environmental impact. (5, 26)

9. Present spill response capability is not sufficient to protect fish and wildlife resources. (4)

10. There have been significant oil spills from winter navigation in the Great Lakes in recent years. (20)

Data Collection & Studies

1. No significant environmental studies have been completed. (5, 6, 23)

2. No baseline data have been completed. (5, 7, 11, 13, 16, 20, 22, 23, 24)

3. The only studies that are completed indicate serious environmental impacts. (22)

4. There are no data on pollution from sinking ships, cargo or fuel spills, bilge or dumped holding tanks. (22)

5. The Survey Study is incomplete. (15)

6. The environmental studies should be under the auspices of an independent agency. (16)

7. System-wide studies done by the Corps have been primarily for collecting existing data. (16)

8. Biological and chemical monitoring criteria are not identified. (13)

9. Not enough is known about the Great Lakes. (1)

10. The environmental studies completed are inadequate. (5, 6, 11, 13)

11. Environmental aspects as well as fish and wildlife are not given enough consideration. (4)

12. The two-year periods scheduled for collecting environmental data are inadequate. A time frame of five to ten years would be more appropriate. (20)

Environmental Plan of Action (EPOA)

1. The EPOA is not designed to accomplish the necessary studies. (15, 25)

2. It fails to address system-wide environmental feasibility. (16)

3. It fails to establish criteria for defining adverse environmental impacts. (16, 20)

4. Summaries of studies in progress should be added. (16)

5. It should define and quantify implementation plans and responsibilities for all studies required. (5)

6. EPOA fails to establish a mechanism for assessing system-wide impacts. (16)

7. EPOA will provide knowledge after the impact has occurred. (23)

8. The absence of Canadian participation in the development of the Environmental Plan of Action and the survey study except for "informal arrangements" ignores the impact that U.S. activities will have on Canadian shores and the fact that NEPA is international in scope. (20)

Shoreline Erosion and Sediment Disturbance

1. Erosion is accelerated by ice breaking and large ship movement. (1, 12, 14, 21, 22, 30)

2. Ice motion effects vegetation. (1)

3. Operational plans fail to offer criteria for below water erosion due to ship passage. (13)

4. If more rapid break-up and decay of ice takes place, the shore may be more vulnerable to spring storms and thus enhanced erosion. (14)

5. Sediment disturbance causes gill clogging and disrupts spawning areas. (22)

6. Redistribution of bottom sediments, caused by vessel passage and dredging activities, is an adverse environmental effect. (12)

7. Pressure waves cause damages to shoreline, disrupts fish and wildlife habitat, and destroys banthos. (4, 11, 23)

8. Pressure waves cause damages to recreation areas. (14)

Dredging

1. Dredging in areas with toxic substances causes those toxins to re-enter the food chain. (4, 34)

2. Dredging destroys the beauty of an area. (19, 21, 34)

3. Fisheries are damaged by dredging. (19, 21, 34)

4. Dredging releases toxins back into the water supply. (4, 22)

5. Water quality is lowered due to dredging. (19, 21, 34)

6. Upland dredging needs a classification of the sediments before dredging can be done. (5, 33)

7. There is not sufficient information available to make a determination as to whether discharge of dredge material, due to project operations, will or will not have adverse affects on municipal water supplies, shellfish beds, fishery areas, wildlife or recreation areas as required by 404(b) guidelines. (5)

8. Spoil deposit sites for large amounts of material should be clearly identified. (5, 33)

9. There are problems in accomplishing dredging during the winter months. (33)

10. The EIS fails to mention adverse environmental affects on aquatic organisms including uptake of heavy metals and toxic organic compounds. (20)

Legal

1. The navigation season extension program activities are, and will be, in violation of the goals of:

(a) the National Environmental Policy Act (NEPA) requiring the identification of the environmental impact of the proposed action and assuring against environmental degradation. (4, 22)

(b) the Clean Water Act mandating improved water quality. (22)

(c) the Great Lakes Water Quality Agreements seeking enhancement of water quality and preservation of the aquatic system. (22)

(d) the Fish & Wildlife Coordination Act providing fish and wildlife conservation be given equal consideration with other project purposes. (22)

(e) the Michigan Constitution and NEPA providing for protection of air, water, and other natural resources from pollution, impairment, and destruction. (22)

2. The draft EIS lists possible sites, but does not include a 404(b) evaluation for specific sites. (5)

3. All major wetlands to be affected must be fully identified and classified in order to permit an environmental assessment in accordance with Executive Order 11990. (5)

4. The Draft Environmental Impact Statement does not comply with the Council on Environmental Quality (CEQ) guidelines or the National Environmental Policy Act (NEPA). (25)

Icebreaking

1. Icebreaking starves ducks and increases energy stress on waterfowl. (23)

2. Potentially serious environmental impacts due to icebreaking include: shore erosion, shore structure damage, destruction of fish and wildlife habitats and wetlands, effects on benthic environments, and oil spills. (5)

3. Levels of icebreaking must be defined. (5)

4. Climatic conditions, geographic locations, and types, sizes, and movement of icebreakers must be quantified. (5)

5. Icebreaking and vessel movement disturb bald eagles. (35)

Other

1. Small water depth changes mean permanent food chain changes. (22)

2. Environmental feasibility of winter navigation has never been shown. (16)

3. The Survey Study does not adequately represent conclusions of the FWS Coordination Act Report. (16)

4. Fisheries will be damaged by winter navigation. (12, 21)

5. Ship movement contributes to potentially dangerous movement of ice which is hazardous to winter sports, fisheries, and other activities. (6)

6. Current EIS should explain when compliance with 404(r) will be achieved. (5)

7. Value of affected wetlands for water quality, flood control, wildlife habitat, hunting, trapping, and sport and commercial fishing should be quantified as indices of benefits or disbenefits of the proposed project. (5)

8. Region 5 FWS concluded as did the State of New York, that the winter navigation season extension program is environmentally unacceptable. (16, 22)

9. Effects of the proposed hydraulic alterations, bubbler systems, increased traffic, and ice control upon maintenance and attainment of water quality standards should be added. (3)

10. The DEIS fails to consider impacts on onshore historic, archeological, or other cultural resources. (4)

11. There should be no authorization for Sandusky Bay and the St. Lawrence River. (4)

12. EIS does not adequately treat Wisconsin's unique fisheries in Duluth-Superior Harbor or the immensely valuable and productive resources of Green Bay. (20)

13. The method for providing shoreline protection does not seem feasible. (20)

14. The value of recreational activities should be compared to the costs associated with damage to the sustaining resource such as productive fish spawning and nursery area. (20)

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